SCIENCE

THE NATIONAL ACADEMY OF SCIENCES[1]

REMARKS OF THE PRESIDENT AT THE DINNER

Members of the Faculty of Brown University, Members of the National Academy of Sciences and Guests:
THE National Academy of Sciences comes to Brown University with greetings to the scientific spirit that has always prevailed within its walls. The basis for this lies in the fact that since the inception of the Academy there has been a continuous liaison between Brown University and the Academy. One of your presidents, Alexis Caswell, was among the founders of the National Academy of Sciences, and members of your faculty have through the years of its existence been elected to membership in it.

In considering what it might be appropriate to say to you on this occasion, it seems to me that the custom established by my predecessors of saying first a word about the Academy, its origin and its functions is in

order. This is an old story to members of the Academy and to those who have had close contact with its permanent committee, the National Research Council. To most people, however, it may not be clear as to just what the Academy is.

Although composed wholly of scientists, the Academy is *not* a scientific society in the ordinary professional sense as is the Physical Society, Chemical Society, etc. It is an organization of limited membership created by Congressional charter (the only one in the field of science) which has certain definite prerogatives and certain definite obligations to the state. These obligations in effect determine the qualifications of those elected to membership.

Principal among the obligations is the one which imposes on the Academy the necessity of giving to the government on request, and without remuneration, the best advice on scientific and engineering matters of major importance. It is this obligation which imposes the double requirement of a membership which covers

broadly the entire field of fundamental and applied science and composed of men of established eminence in each field. It is an Academy in the true sense that every man or women elected to it has a record of proven creative accomplishment in his chosen field. It is consequently an organization of mature people.

The idea of an organization of some kind to give authoritative advice to the government in the field of science was not new at the time the Academy was chartered during the Civil War. It arose in colonial times because the question was continuously coming up with the settlers as to what could best be done with the abundance of natural resources at hand. Ways and means were considered and abandoned, only to be taken up again from time to time.

Benjamin Franklin thought the American Philosophical Society would be able to take care of investigations (that is, as to their value) and, if worth while, the members might be able to carry on the experimental work needed. Then the National Institute and later the American Association for the Advancement of Science were more or less thought of in their inception as advisory bodies to the National Government. None of them seemed to be just what was needed, however, and after considerable discussion between 1848 and 1862, the idea of founding a new body that would be recognized by Congress, to advise the Federal Government in scientific matters, to meet the needs of the time, began to crystallize. Combined with this and as a part of the broad consideration was the idea of honoring men of eminence by election to membership on the basis of their noteworthy contributions to knowledge in their fields of the natural sciences.

The Academy has had an eventful career over the seventy-six years of its existence, considering and reporting on many perplexing questions and problems which have confronted government, and the help given has fully justified the establishment of such a body.

This is neither the time nor the occasion on which to review the work accomplished in three quarters of a century of service as scientific adviser to the government. The problems have been as varied as the fundamental investigations required to adapt the magnetic compass to reliable use on ironclad vessels—a problem made patent at the time the *Monitor* and *Merrimac* battled; the geological investigations of the Panama Canal slides by a committee of the Academy on whose findings were based the methods of control adopted; the many problems of the World War days and in more recent and peaceful times the host of problems presented to the Science Advisory Board and the National Research Council.

The National Research Council, just mentioned, is a permanent operating agency of the Academy designed to broaden the base of its service to the nation. It originated in the vast complexities of major scientific problems of the war and post-war days. It w established by the Academy at the request of Preside Wilson and was made a permanent part of the Aca emy set-up in response to an executive order whi he issued.

The Academy and Council together constitute organization which is at all times and at short not in position to bring to bear on any problems in the fi of science the best talent that the nation has.

In addition to its advisory functions the Acade as a whole holds two meetings a year for the present tion of scientific papers and the conduct of its co porate affairs. The annual meeting at the Acade building in Washington each spring is also the ti when new members are elected. The fall meeting held at some scientific center, where brief summari of the latest accomplishments in science are presente

So much by way of explaining what the Academy and how it came to be. Now a few words in a qu different vein but one which, it seems to me, is prop in a person of my antecedents.

In electing an applied scientist and engineer to i presidency, the Academy broke with the traditions the past. Why, I do not know, unless it was becau of a feeling that experience in the art of applicati might be helpful at this time in assisting the Academ to discharge its obligations as scientific adviser to t Government. Possibly my views on many matte concerned with science and its applications are n traditional ones, and in these concluding remarks lay no claim to any considerable wisdom.

It is an old adage which counsels the shoemaker stick to his last. In what I shall say to-night, I pr pose to take this maxim very much to heart. Th American scene unfortunately suggests from time time that this sage advice may have fallen into dis repute in certain quarters. If so, I suspect it is b cause of our own short-sightedness and not becau of any obsoleteness in the adage. It is usually not pleasant spectacle to behold a person who, having at tained eminence in one field, casts a shadow across h own reputation by assuming to exhort his fellows i spheres of actions in which he has had no experienc It reminds me of a subtle combination of wit an wisdom which Sir Richard Gregory introduced me t while he was making his recent visit to this countr As I recall it, he said that a member of Parliamen admonished the House one day that it was always good plan to have an expert on *tap* but never on *to*

Now, I am a specialist, an expert if you please— fact for which I make no apology—and it is as suc that I wish to stand before you to-day; viz., one who on *tap* but not on *top*.

As to my specialty, there is a great deal that coul be said on such an occasion and at such a time as thi We live and, what is perhaps even more important

fight in the midst of applied science, and with the tools and weapons which applied science has given us. This is certainly not the *fault* of science; neither does the responsibility for correcting the situation lie solely at the door of science. It is a problem as broad as society itself, and while the scientist very assuredly ought to have helpful suggestions which he can offer, he ought for his own sake to be cautious in delivering himself of panaceas. Perhaps our position is somewhat analogous to that of the chemist who synthesizes a new narcotic—he stands ready to advise regarding its making and its properties but leaves the matter of control in the hands of society through its appointed agents. To push the analogy farther than this would, I am afraid, be to risk the danger of overworking it. The narcotic problem is absurdly simple compared to that involved in the wise assimilation of science; more particularly the beneficent uses of the narcotic may be vanishingly small compared to its potentialities for harm, whereas we hope—perhaps we are incorrigible optimists in such hoping—that the contrary is true of science.

It is quite apparent that the administration of science has two very distinct aspects—one the national, the other the international—and that no competent agencies exist for dealing with either. This situation would on the whole appear to be a fortunate one. Certainly nothing could be more inimical with respect to future progress than an over-developed administrative agency which is insufficiently guided by wisdom, experience and accurate analysis of the problems to be met. Fortunately the affair is still largely fluid and such attempts at crystallization as have been made have as yet had little effect. But let us not drop into a state of indifference as a result of this. While we need scarcely fear that we are confronted at the moment with a condition of supersaturation or of supercooling, we must not forget that the National Academy bears a double responsibility. It is at the same time spokesman for the sciences collectively and the chief scientific adviser to the government. This, in itself, makes our position one calling for careful study. In the words of Pooh-Bah, the Lord High Everything Else, we may, as official representative of American science, declare in favor of untrammeled liberty for fundamental and applied research; or we may, as Lord High Councilor on Science to a Government which for a complex assembly of reasons and motives is drifting in the direction of socialization, make suggestions which might urge on the present drift.

Now, when I say that *we may* do these things, do not misunderstand me. I do not wish to imply that we ought to feel a special urge to do them now or even within perhaps the coming decade, nor do I mean to imply that we will so soon as this be asked for our advice upon this exceedingly complex matter. My thought is one solely of preparedness. There is abundant evidence that for a considerable period of time the tide has been drifting in the direction of increased intermeshing of social forces and increased centralization of control, and that the causes for the tide appear such as to suggest that as yet we have by no means reached the high-water mark. If this hypothesis is true—or, better, if it is not definitely known to be untrue—then I suggest that it is incumbent upon us, both because we are scientists and as such are eager to preserve the liberties of science, and because we are chief scientific adviser to the Federal Government and, therefore, in duty bound to give unprejudiced advice to this agency of the people as a whole, to give heed to the tide. In some way we must merge our collective talents so that to whatever extent is humanly possible, we will arrive at a long-range broad-visioned forecast of the sociological significance of our specialities when taken collectively and when integrated—as is steadily being done—into the fabric of our daily lives.

Let me caution again that I do not visualize this task as one which we can assume at a given moment and conclude at an equally definite but later moment. It is one with which, as I see it, we must be reconciled to living through the years to come. The objective of the present day will have been achieved if we accept the reality of the problem and regard it as one demanding conscious analysis and constructive thought to a degree greater than we as a body have accorded it in the past.

In conclusion, I return again to the adage of the shoemaker. We are all specialists and each must stick to his last. At the same time, as an Academy we are a single, although composite, expert, and as such we should be in possession of faculties at least as comprehensive as are anywhere else attainable. The future, even more than the present, promises to require cooperative effort—and in this problem, which we might denote as the socialization of science, we meet in transcendent form a challenge to our collective talents.

FRANK B. JEWETT

ABSTRACTS OF PAPERS

The sensory cortex of the chimpanzee's brain: J. G. DUSSER DE BARENNE (introduced by W. R. Miles). Local strychninization, *i.e.*, strychninization of a few square millimeters, of the sensory cortex of an anesthetized animal results in typical changes of the electrical activity of this cortex, *i.e.*, the appearance of large and rapid voltage fluctuations, *strychnine-spikes*, in its electrocorticogram. These spikes not only appear in the electrogram taken at the site of strychninization but also in the electrograms from areas functionally related to the strychninized area. In this way it is possible to delimit the sensory cortex in the anesthetized animal. Thus, in collaboration with Dr. W. S. McCulloch, the location and extent of the chimpanzee's sensory cortex was determined. It proved to be a very large region, located both in front and behind the

fissura centralis and subdivided in three major subdivisions: a face-, and arm- and a leg-area.

Rhythmic electrical discharges from nerve cells in relation to their respiration: HUDSON HOAGLAND (introduced by W. S. Hunter). Most nerve centers of both vertebrates and invertebrates show rhythmic voltage fluctuations at frequencies ranging roughly between one and thirty per second. The regular sinusoidal ''alpha'' brain waves (Berger rhythms) of about ten per second recorded from large areas of the human cerebral cortex furnish an outstanding example of the phenomena. It is probable, from what is known of other cells, that brain cells produce potential gradients as a by-product of their respiratory metabolism. These may be of the nature of diffusion potentials across the cell membranes which possess definite electrical impedance and which discharge when the potentials reach a critical value. In such a system the discharge frequency would depend on the speed with which the metabolic factor can load the capacities of the cell walls to their critical firing potentials. The absolute frequency would thus be determined by the rate of cellular respiration *and* by the electrical impedance of the cell walls. If this last be statistically constant for a particular group of cells under the conditions of the experiments the *frequency* should parallel and be a measure of changes in cortical respiration. To test this hypothesis of the mechanism of brain waves a number of studies have been carried out by the writer and his collaborators. Metabolic stimulants such as dinitrophenol and thyroxin increase the frequencies of alpha waves. Markedly lowering blood sugar, thus depriving the brain of its principal fuel, or markedly lowering the brain's oxygen consumption slows alpha frequencies. Studies of the effect of temperature on the frequencies of brain waves and, *in vitro*, temperature studies of the kinetics of simple enzyme systems known to be functional in brain respiration have furnished information as to how one or the other of the links in the chemical chain constituting cortical respiration may act as chemical pacemaker or master reaction. Under certain conditions, for example, we have been able to show that the dehydrogenation of succinate may be the pacemaker step; in other conditions it may be the cytochrome oxygen activating link. This work has been applied specifically to the analysis of chemical pacemaker changes in advancing brain syphilis (general paresis).

The acquisition, extinction and spontaneous recovery of a conditioned operant response: C. H. GRAHAM and R. M. GAGNÉ (introduced by W. S. Hunter). This study has been concerned with an analysis of the changes in strength of a conditioned operant response which occur as functions of reinforcement, non-reinforcement and spontaneous recovery. The apparatus consists of a simple runway, at one end of which is a starting-box and at the other end a food-box. The measure of response which we have used is termed the latent period. This is defined as the time taken by the animal to leave the starting-box before traversing the runway to food. The latent period for twenty-one male white rats was measured in fifteen reinforced trials, with a constant interval of 75 seconds between successive trials. A curve of acquisition is presented, revealing a response which begins with a log latent period value of 1.85 (corresponding to 71 seconds) and falls off with negative deceleration to reach a log value of 0.45 (2.8 seconds) at the fifteenth trial. The curve exhibits a nine-fold change in latent period from the second to the fifteenth trial. Changes in the latent period of response during extinction were recorded in forty-one rats, the trials being spaced at the same constant 75-second interval as in acquisition. The process of extinction is depicted in a curve showing the change in latent period of response during five unreinforced trials. This curve begins at a log latent period value of about 0.40 (2.6 seconds) and rises with negative acceleration to a log value of 1.33 (21 seconds). Thus during extinction the magnitude of the latent period increases in the ratio of nine to one. Spontaneous recovery of the response was measured after extinction had proceeded to a criterion of a 3-minute latent period. Recovery was tested in twenty rats, five at each of four recovery intervals of no stimulation. The intervals used were 1 minute, 3 minutes, 6 minutes and 10 minutes. The progress of spontaneous recovery in these intervals is shown in the form of a graph. Recovery is rapid during the first three minutes, but after 6 minutes the rate decreases rapidly. The recovery after 10 minutes is not complete, as indicated by the fact that latent period is still of the order of 35 seconds. A theoretical discussion of the results is presented. This considers changes in an internal condition of excitation which may account for a number of the processes involved in conditioning.

Experimental modification of the polarity potential of the human eye: WALTER R. MILES. The steady potential existing between the anterior and posterior poles of the eyeball has been measured by means of electrodes applied to the skin on either side of the eye. When the eye is turned the cornea is brought nearer to one electrode, which then becomes positive, while the other is negative. The potential registered under standardized objective conditions shows a rather steady value for a given individual but is influenced somewhat by the subjective factors of apprehension and relaxation. The present report considers the possibility of temporarily modifying the steady potential of the eye. For this purpose small amounts of sodium chloride solution were instilled into the conjunctival sac. Shortly after this application of hypertonic solution to the anterior portion of the eye a marked increase in the eye potential was found present and persisted for several minutes. The change, studied on 18 young women, showed an average increase which amounted to two times the standard deviation of the pre-salt mean value and is thus a highly reliable indication of an induced modification of the polarity potential. In some instances the hypertonic salt solution gave rise to a second phenomenon which may be interpreted as a ''diffusion potential.'' This occurred when the eye was turned 30° laterally from the primary line of regard, and a part of the salt-soaked sclera thus came into contact with tissue of lower salt content. Diffusion potentials of this character were also found in rare cases (out of a population of 200 examinations) occurring spontaneously without the experimenter having instilled hypertonic solutions.

The theory of the visual threshold. W. J. CROZIER (introduced by W. S. Hunter). The physical interpretation of data of sensory excitability necessarily implies a theory of the nature of the effects responsible for threshold discrimination. The common assumption, sometimes only implicit, has been to the effect that in visual performance, for example, threshold effects are equal or equivalent. That they are really equivalent in any meaningful sense has never been demonstrated. A detailed examination of human visual thresholds ("absolute" and relative) shows that the interrelationships among the effects due to such variables as area, exposure time, intensity and wavelength, at a number of retinal locations, are such as to demonstrate that in homogeneous data the form of the quantitative dependence of the threshold intensity upon any one of the other variables depends upon the magnitudes of the rest. Before it can be attempted to provide a coherent account of the nature of the neural disturbance at the discriminatory threshold, means must be found for analytically separating the specifically statistical properties of the relevant elements of neural action from those which may reveal the physico-chemical character of the excitatory and discriminative processes. Indications can be given as to the directions which such analysis may take. The interrelations of time and intensity provide one illustration of the role of purely statistical considerations. It does not seem profitable to regard the data of intensity discrimination under fixed conditions as in general resulting from a physically fixed quantity of sensory disturbance.

Localization of response in the cochlea as determined by electrical recording: E. H. KEMP and PARKER JOHNSON (introduced by W. S. Hunter). Electrical responses from the cochlea of the guinea pig were studied by means of an amplifier, a cathode-ray oscillograph and a wave-analyzer. The guinea pig was anesthetized with dial and urethane, put under artificial respiration and placed in a "soundproof" room. A beat-frequency oscillator, attenuator and speaker provided tones which were delivered to the ear of the guinea pig through a rubber tube and a speculum which had been sewed into the external meatus. The cochlear response to frequencies of 100, 200, 400, 600, 1,000, 2,000, 4,000 and 6,000 cycles per second was recorded from selected positions on each turn of the cochlea. For each frequency a series of intensities was used and a log response—log relative sound intensity curve obtained. From these curves the relative intensity of sound of each frequency necessary to elicit a response of three microvolts was determined for each recording position. The data obtained make it possible to construct a map of the cochlea which meets the requirements of the place theory of audition, and which confirms a map of the cochlea previously constructed by Culler from data obtained by a somewhat different method.

The effect of direct current stimulation on the contractions and the electrical behavior of the oyster heart: IVON R. TAYLOR and EDWARD M. WALZL (introduced by C. A. Kraus). The makes and breaks of a direct current (4–13½ volts), applied to the ventricle of the excised, perfused oyster heart, were timed to occur at certain phases of the cardiac cycle as the mechanigrams and electrograms were recorded simultaneously. An action potential, due to a propagated wave, was produced when the break of the current occurred at full systole or later in the cardiac cycle, but no such effect was produced, in any phase of the cycle, due to the make. A slow electrical wave, probably due to local polarization of the tissues, was sometimes observed on the make. During contraction of the ventricle, a make caused a decrease in the amplitude and duration of systole, and a break produced the reverse effects. During relaxation, a make favored relaxation, but a break caused a contraction with amplitude and duration greater than normal. The above and additional results lend support to a previous report by Walzl to the effect that the make and the passage of a direct current cause inhibition but the break, excitation of the oyster ventricle. During the constant passage of the direct current, the spontaneous action potentials were markedly increased in amplitude, usually, although the ventricle was in a partly inhibited state. This effect is probably due to an increased polarization of the surface of the tissue. The amplitude of the spontaneous action potential appeared to vary parallel with the initial length of the ventricular tissue.

The effects of biologically conditioned medium on the growth rate and population yield of certain ciliated protozoa: GEORGE W. KIDDER (introduced by W. S. Hunter). Three species of holotrichous ciliates were used in this study, *Colpidium campylum, C. striatum* and *Glaucoma pyriformis.* They were grown in bacteria-free, particulate-free culture and tested as to growth rate and population yield in fresh broth (proteose-peptone), broth from which a previous population had been removed by centrifugation and broth from which a previous population had been removed by filtration. No significant difference was observed between the growth phases of the three species, but large and significant differences occurred between the different types of media. In fresh broth (control) growth proceeds logarithmicly for about 36 hours (initial inoculum of 100 to 150 cells) then levels sharply and continues in the stationary phase for weeks. When the same number of cells are inoculated into conditioned broth (from which a previous population has been removed by centrifugation) there is a significant acceleration of growth during the early periods with a gradual slowing of the growth rate. The maximum population yield is always lower than the control. When the same number of cells are inoculated into filtered conditioned broth (the previous population having been removed by a Seitz filter) there occurs a significant lag period with a final population yield similar to that of the conditioned broth. Both the accelerative and the depressive effects are destroyed by heat and the accelerative effect is decreased in direct proportion to the length of time the conditioning is carried out. We may postulate the elaboration of two substances within the culture medium as a result of the population growth, one an accelerator to growth which appears to be adsorbed on a negative filter and the other a depressor which, when allowed to act independently of the accelerator, produces

a pronounced lag in the growth rate of a second population of ciliates. These two substances are thought of as being produced simultaneously but at different rates during any population growth.

Analysis of variance applied to human genetics: C. B. DAVENPORT. The analysis of variance as developed by "Student" and R. A. Fisher has been used hitherto to differentiate races of animals and plants but apparently not to compare intrafamilial with interfamilial difference to get a measure of the importance of heredity in human family traits. In 7 families containing 5 to 3 Nordic boys each, at age of 16 years at time of observation, the variation between families and within families of 14 dimensions was computed. The results are as follows: In all 14 cases, with degrees of freedom of 6 for the greater mean square and 17 for the less the F value ranges from 2.40 to 2.65 (2 cases), through 2.96 and 3.86 (2 cases) to over 4.10 (10 cases). The ratio that may be exceeded by chance 5 times in 100 trials is 2.70; by chance once in 100 trials is 4.10. Accordingly, the adjusted ratio of intrafamilial to interfamilial variation may be given, by chance, slightly more than 5 times in 100 trials in 2 cases; between 5 times and 1 time in 100 trials in 2 cases; and less than 1 time in 100 trials in 10 cases. Thus, in all families variation within families is significantly less than between families. The difference is much more significant (perhaps because the genetical factors are stronger) in the various head widths than in the elements of facial height.

Bodily constitution and longevity: RAYMOND PEARL and W. EDWIN MOFFETT. There were observed and measured 2,332 adult white males falling in six series on the basis of the eventual causes of their deaths. All were in a state of sound health when observed. In each cause-of-death series there were two groups of individuals separated upon the basis of duration of life. The Longevity (+) group in each series contained every individual in our total material for that series, without other selection, whose survival after observation was *greater* than the expectation of life for his age when observed as given by the Dublin and Lotka 1929–31 life table. The *average* ages at death of the Longevity (+) groups ranged from 75.0 years in the cancer series to 77.2 years in the nephritis series. The Longevity (−) group in each series contained the shortest-lived individuals to be found in that series who were, individual for individual, of the same age in years at observation and measurement as the individuals in the Longevity (+) series with whom they were paired. Their average ages at death ranged from 40.2 years in the accident series to 54.7 years in the diabetes series. The Longevity (+) group outlived the Longevity (−) by average amounts varying from about 21 years in the diabetes series to about 36 years in the accident series. The Longevity (+) group was not significantly differentiated from the Longevity (−) group in any series in respect of mean *stature* or in mean *chest expansion* at the time of disease-free observation. The same was true of mean *body weight* in the pneumonia series and in the accident series. But in the heart disease, and the nephritis series, the mean *body weight* and mean *chest girths* were significantly greater in the Longevity (−) group than in the Longevity (+) group. Mean *pulse rate* was higher in the short-lived (−) groups in all cause-of-death series, but not significantly so in the accident or pneumonia series. Further details regarding other constitutional differentiations between the long-lived and short-lived groups are given in the complete paper.

Inheritance of internal morphological characters: PAUL B. SAWIN (introduced by W. S. Hunter). Irregularities in the number of pairs of ribs and of presacral vertebrae and of other internal morphological structures are anomalous variations described in numerous species and in all classes of tetrapods. Evidence of inheritance has been presented by several investigators as the result of study of corresponding variations in the domestic fowl, the rabbit, mouse and man, but in none is a simple mendelian interpretation adequate to explain all the facts. In the rabbit our extensive breeding within three closely bred families shows that by selection in two of them (IIc and III) the proportion of 13-ribbed progeny has been increased from 86.6 per cent. and 76.3 per cent. to 94.7 per cent. and 97.7 per cent., respectively, whereas random mating within a third family (V) has induced but minor change over seven generations. Crosses of the two 13-ribbed families with the same 12-ribbed family reveal tendencies for the 12-ribbed type to dominate in the first generation and to segregate in subsequent backcross generations in expected mendelian manner but with aberrant proportions of 12- and 13-ribbed progeny roughly corresponding to the respective disproportion existing in the parental families. This is indicative of minor genetic differences between these two 13-ribbed families, although crosses between the two have produced only 13-ribbed young. A cross between one of the 13-ribbed families (III) and the 12-ribbed individuals of the unselected family V has produced 40 young, 66 per cent. of which are 13-ribbed, and which continue to breed as 13-ribbed. This could be explained on the basis of parental unifactorial hybridity of the family V parents. This interpretation is erroneous, however, since analysis of 134 matings within this family shows that segregation is neither unifactorial nor fortuitous. Similar studies of anomalies of the sternum and of the vascular branches arising from the aortic arch, dorsal aorta and inferior vena cava within the same families show patterns of incidence of anomalies typical for each family, but for which at present likewise no simple mendelian explanation is completely adequate. The author is inclined at present to consider a multifactorial explanation parallel to that suggested by several investigators for adult body size as the more likely, although body size itself is not directly correlated at least with the skeletal variations. The high familial incidence of these anomalies, which are associated with regions (branchial and urogenital) subject to great evolutionary vicissitudes, coupled with the regularity of their transmission in crosses, offers a new approach to problems in vertebrate evolution through the combined application of the principles of comparative anatomy and genetics.

A study relating to cytoplasmic effects of uniparental inheritance in Daphnia: A. M. BANTA and THELMA R.

OD (introduced by C. A. Kraus). In biparental inheri-
ce reciprocal crosses between stocks of *Daphnia longi-
a* possessing either of the mutant characters studied,
avated head or sex intergradedness, it was found that
n the eggs came from the mutant-bearing stock and the
rm from the normal (non-mutant-bearing) stock the
ually produced offspring, about 50 per cent. of which
ried the character, produced a higher average manifes-
ion of the character involved than when the cross was
de in the reverse direction. The differences in reciprocal
sses appeared conclusive. Such a result may find expla-
ion in that the factors for the mutant characters affect
cytoplasm of the egg previous to fertilization. Inas-
ch as parthenogenesis in Daphnia is diploid, there theo-
ically being no opportunity for genie segregation dur-
the one non-reductional maturation division of the
s, all the parthenogenetic descendants of an individual
uld be genetically identical, except as a mutation
urs. However, with the two mutant characters studied,
th of which are highly variable in their manifestation,
ere was strong presumptive evidence that even among
rthenogenetically produced clutch mates, a mother
enotypically low for the character produced unipa-
ntal, diploid offspring with a slightly lower average
anifestation of the character than did her clutch mates
ich themselves were phenotypically higher for the char-
ter involved. Only cytoplasmic influences would seem
account for such a result. In an attempt to get critical
idence concerning such cytoplasmic effects experiments
ere set up as follows: Clutch sisters having different
ades of manifestation of the mutant character were
ared in individual bottles of the same culture medium
der as nearly identical conditions as could be provided.
s many parthenogenetic young as possible were obtained
om each mother. The offspring from each mother were
aded with reference to the manifestation of the char-
ter. An average grade for all the offspring from each
other, in many cases 150 to more than 300 per mother,
as thus obtained. The general average grade of off-
pring from mothers which were phenotypically of one
rade of expression of the character was then compared
ith averages for offspring from mothers having other
rades of expression of the character studied. The data
hus obtained for the excavated head character reveal no
idence for a cytoplasmic effect in the inheritance of
his character in parthenogenesis. On the other hand,
xtensive data (which will be presented) for the sex
ntergrade character appear to confirm the earlier evi-
ence which suggested cytoplasmic effects in inheritance
parthenogenesis.

*The effect of calcium on potassium retention in skeletal
muscle:* P. H. MITCHELL and L. SARIN (introduced by
C. A. Kraus). Pairs of frog sartorius muscles were used
as control and experimental material. They were im-
mersed in Ringer solution or in Ringer modified as to its
calcium concentration. The control was kept at rest; the
experimental muscle was directly excited electrically to
give tetanus contractions of one third second duration at
intervals of 20 seconds. Confirmatory of previous work
at this laboratory and elsewhere, potassium losses were

noted from stimulated muscles only. If stimulation was
continued during two hours, large potassium losses,
amounting to about 30 per cent. of the total muscle potas-
sium, were observed when the muscles were in Ringer
solutions containing 12 to 24 milligrams per cent. of cal-
cium chloride. With 36 milligrams per cent., the potas-
sium losses fell to about 15 per cent. of the total muscle
potassium. If stimulation was continued during only one
hour the potassium losses became smaller as the calcium
chloride concentration was increased. In the presence of
36 milligrams per cent. of calcium chloride, the losses were
too small to be detected by the method of chemical analy-
sis employed. It is suggested that increase in calcium
concentrations may so affect the muscle cell surfaces as
to alter the normal permeability relations and check or
even prevent loss of potassium during excitation and con-
traction.

The isolation, constitution and synthesis of Vitamin K_1:
E. A. DOISY, D. W. MACCORQUODALE, S. A. THAYER, S. B.
BINKLEY and R. W. MCKEE. Evidence of the existence
of an anti-hemorrhagic factor was first obtained by Dam
in 1929; in 1935, he suggested the term Vitamin K for
this factor. The difficult and laborious tasks of develop-
ing satisfactory bioassay procedures and of devising
methods for purification of the vitamin were undertaken
mainly by Dam and his collaborators in Europe and by
Almquist and his co-workers at the University of Califor-
nia and by our group at the St. Louis University School
of Medicine. Dried alfalfa leaf meal and putrefied
sardine meal were found to be satisfactory sources of the
vitamin. We have isolated an anti-hemorrhagic compound
in a pure state from each source. Chemical reactions and
ultra-violet absorption curves have indicated clearly that
both of these compounds are derivatives of 1,4-naphtho-
quinone. By oxidation experiments it has been shown that
Vitamin K_1 (alfalfa) is 2-methyl-3-phytyl-1,4-naphtho-
quinone. This structure has been confirmed by synthesis,
and degradation experiments on the synthetic compound
have given the same products that were obtained by oxida-
tion of the natural compound. As soon as the quinonoid
structure of Vitamin K was recognized various simple
quinones were tested for Vitamin K activity. Only 1,4-
naphthoquinones and compounds which upon oxidation in
the organism might yield 1,4-naphthoquinones showed
activity. 2-methyl-1,4-naphthoquinone is at least as active
as Vitamin K_1. 1,4-dihydroxy-2-methylnaphthalene and
4-amino-2-methyl-1-naphthol possess approximately the
same potency as Vitamin K_1. These two compounds are of
great importance from a therapeutic standpoint, since they
are soluble in aqueous media and therefore can be used
for parenteral therapy. This is important because of the
difficulty in securing absorption of the enterally adminis-
tered natural vitamin, which because of its oily character
can not be used intravenously.

*The medical cyclotron of the William H. Crocker Radia-
tion Laboratory:* ERNEST O. LAWRENCE. The new 60-inch
cyclotron of the William H. Crocker Radiation Labora-
tory, weighing over 220 tons, is the largest one yet built
and has many important new features of design. The im-
provements have greatly increased the efficiency of the ap-

paratus over smaller models, as evidenced by the fact that 100 microamperes of 16 million volt deuterons and 1 microampere of 32 million volt helium ions are obtained with only 50 kilowatts input to the radiofrequency oscillator. The first experiments with these atomic projectiles of considerably greater energies than heretofore available have given extraordinarily interesting results. It has been observed, for example, that the neutron yield per microampere of deuterons is 5 times greater at 16 million volts than at 8 million volts, while the yield of radioactive iodine is 20 times greater at the higher voltage. Moreover, bombarding bismuth and lead with 32 million volt helium ions gives rise to large yields of new alpha particle emitting radioactive substances. The gratifying initial performance of the new cyclotron, which indeed has surpassed expectations, makes it certain now that it is entirely feasible to build a 120-inch (2,000 tons) cyclotron capable of producing atomic projectiles of energies above 100 million volts. The rapid and successful construction of the 60-inch cyclotron, which is of great importance for medicine as well as for the physical sciences, was made possible through the joint efforts of all the members of the Radiation Laboratory and through the active interest and generous support of the Chemical Foundation, the Rockefeller Foundation and the National Advisory Cancer Council.

Auditory patterns, a demonstration lecture: HARVEY FLETCHER. For many years physicists have been devising methods and apparatus for accurately measuring hearing, and it is now possible to describe the ear in physical terms much as other machines are described. In more recent years, auditory research has been directed more toward obtaining the relation between such a physical description and the character of the sensation evoked by a sound. Sound waves entering the inner ear set into vibration a relatively long flexible membrane, which has distributed along its length the endings of the auditory nerve fibers. These endings are sensitive to the vibrations, and initiate a series of nerve impulses or tiny electrical currents, which travel along the nerve fibers to the brain. Such nerve messages contain the information that is used in forming the sensation of sound. By utilizing the discovery that human nerve fibers behave like busy telephone wires, relations have been obtained between the physical characteristics of a sound and the pattern of the nerve messages which it produces. When a nerve fiber is busy carrying messages for one sound it is unable to carry messages for a second sound. In order to be heard, the intensity of the second sound must be increased until nonbusy fibers can be found. From such busy tests, the fibers at different positions on the membrane that are excited by a given sound can be charted. Such a chart is called an auditory pattern, and portrays to the eye the information that the brain must utilize in order to form sensation. By choosing a sound which renders the fibers at different positions on the membrane uniformly busy, relations have been obtained between the pitch of a sound and the position of the excited fibers, the intensity of a sound and the rate at which messages are evoked and the changes in position and rate which accompany just notice-

able changes in pitch and intensity, respectively. In ··· demonstration lecture, this complicated process is viv··· depicted by creating sounds and portraying the co··· sponding auditory patterns by means of animated cha··· Deafness is artificially created and the audience sees ··· hears sound in the roles of both the normal hearing ··· the deafened.

A Raoult law study of chlorbenzene-symtetrachloreth··· mixtures: JOHN R. LACHER (introduced by C. A. Kra··· An equilibrium still is described which permits a fa··· rapid determination of vapor-liquid equilibrium. T··· apparatus is flexible and enables one to determine wheth··· or not the steady state set up is independent of the fac··· required to bring it about. Pressure composition ··· therms of chlorbenzene-symtetrachlorethane mixtures w··· determined at 75° and 100° C. The deviations from ··· ideal solution law are small and negative. The measu··· ments satisfy the Gibbs-Duhem-Margules' equation with··· experimental error. That the solutions should be nea··· ideal is indicated by the fact that the molar volumes ··· the two pure liquids differ by only 4 per cent. at 30° ··· Density measurements of the liquid mixtures show th··· there is a small decrease in volume on mixing. T··· shows that the attractive forces between the unlike mo··· cules should produce small negative deviations from ··· ideal solution law, as were observed.

*Mixed copper-chromium oxide hydrogenation cataly··· V. N. IPATIEFF, B. B. CORSON and J. D. KURBATOV. Pu··· copper does not hydrogenate benzene at ordinary press··· and 225°, but the presence of chromium oxide enables ··· to do so. As chromium oxide is added to copper, th··· hydrogenating activity rises abruptly to a maximum at ··· per cent. of oxide, and then falls with continued additio··· The same is true for the hydrogenation of isopentene ··· ordinary pressure and of benzene at superatmospher··· pressure. We have called this mixture of maximum acti··· ity the ''eucoactic mixture.'' The presence of 0.1 p··· cent. of chromium oxide lowers the temperature requir··· ment for the hydrogenation of isopentene from 225° ··· 75°. Copper is very susceptible to activation by tra··· of nickel, and the 95 per cent. copper-5 per cent. chromi··· oxide catalyst is even more susceptible. For instan··· copper containing not more than 0.001 per cent. of nic··· does not hydrogenate benzene at ordinary pressure a··· 225° in 90 seconds, whereas the presence of 0.005 per c··· of nickel raises the hydrogenation to 4 per cent. On ··· other hand, the hydrogenating activity of the 95 per ce··· copper-5 per cent. chromium oxide catalyst is raised fro··· 4 per cent. to 16 per cent. by the addition of 0.005 p··· cent. of nickel. Also, copper containing 0.2 per cent. ··· nickel hydrogenates benzene 19 per cent. in 12 second··· contact time, whereas the 95 per cent. copper-5 per ce··· chromium oxide catalyst, to which 0.2 per cent. of nick··· has been added, hydrogenates benzene 62 per cent. I··· the absence of nickel, the copper-chromium oxide cataly··· hydrogenates benzene only 2 per cent. in 12 seconds.

Line absorption spectra of solid compounds: JOHN ··· HOWE and W. S. HERBERT (introduced by C. A. Kraus··· Neodymium acetylacetonate has been chosen as a com···

ound, the study of whose absorption spectra should give data bearing on the subject of energy levels in solids. It has been shown by various workers that the color of rare earth compounds is due to transitions between levels of $(4f)^n$ electronic configurations of the triply ionized rare earth ion. These levels being highly degenerate are split in the electric fields due to the charged groups surrounding the ion in a solid. The splitting pattern depends on the electronic level involved and the symmetry of the electrical field. The absorption spectrum of neodymium acetylacetonate has been photographed with the compound at 78°, 120°, 193° and 298° Kelvin. From the results, an energy level diagram has been constructed which is consistent with the assumption of a field of nearly octahedral symmetry about the rare earth ion. A small axial field is indicated. In addition, it was necessary to assume that a molecular vibration frequency couples with the electronic transitions. The splitting pattern of the ground state is similar to that observed in other neodymium salts. All the observed lines are accounted for except one group which appears to rise from transitions to two electronic states lying close enough together to mix up.

Work functions of different faces of silver single crystals: H. E. FARNSWORTH and RALPH P. WINCH (introduced by C. A. Kraus). The work required to transport an electron through the (100) and (111) faces of silver single crystals has been determined by a photoelectric method after extended outgassing of the crystals. The equilibrium value of this work function for the (100) face is 4.81 ± .01 electron volts. This value was obtained after 2,283 hours of heating at temperatures up to about 700° C; 356 hours of additional heating did not change this value. After the crystal had subsequently remained at room temperature for 2,130 hours, at a pressure of 1 to 3×10^{-8} mm Hg, the work function decreased to 4.65 e.v. After 100 hours of additional heating of the crystal the work function increased to 4.79 e.v., and after an additional 118 hours of heating it returned to the equilibrium value of 4.81 e.v. The equilibrium value of 4.75 + .01 e.v. for the (111) face was obtained after 1,227 hours of heating at temperatures similar to those above. This crystal had been outgassed in two previous experiments so that a much shorter time was required to reach the equilibrium value of the work function than for the (100) face. The above equilibrium value was not changed by 407 hours of additional heating. At this time the crystal became slightly contaminated while heating a tantalum plate near it. The effect of the contamination was to cause a failure of the experimental results to fit the Fowler theoretical curve. Measurements on the contact potential difference between the two crystal faces by the Kelvin null method agreed with the difference of the photoelectric work functions to within + .01 volt until the results for the (111) face failed to fit the Fowler theoretical curve. We believe that these values are the best that can be obtained by heating, since silver crystals etch rapidly, thus exposing other faces, when heated at temperatures where appreciable evaporation occurs. The above values may be compared with 4.74 e.v., previously obtained by Winch (*Physical Review*, 37: 1269, 1931; 38:

45, 1931), for polycrystalline silver after heating for 1,200 hours with short intervals at temperatures as high as 850° C. where evaporation is rapid.

The filtration of sound in non-homogeneous media: R. B. LINDSAY (introduced by C. A. Kraus). Previous work (*e.g.*, Lindsay, Lewis and Albright, *Jour. Acoustical Soc. Amer.*, 5: 202, 1934) has indicated that when periodic compressional elastic waves pass through a stratified medium consisting of a series of alternating layers of two different substances, which may be either fluid or solid, not all frequencies are transmitted. In other words, the medium acts as an acoustic filter with alternate transmission and attenuation frequency bands. This analysis of the transmission characteristics of the medium was based on the assumption that the transition in acoustical properties (*i.e.*, density and sound velocity) from each layer to the next is *abrupt* and effectively discontinuous. The purpose of the present investigation is to examine the consequences of assuming that the transition in question is a *gradual* one. The interesting theoretical result is that for a gradual transition in which there are no discontinuous changes in either the acoustical properties or their gradients the stratified medium no longer acts as a filter but passes all frequencies equally well. In order to assure filtration for a gradual transition one must assume at least discontinuity in the gradients of the acoustical parameters. Certain special cases and their consequences are investigated.

Excitation of fractional multiplets by electron capture: GEORGE H. SHORTLEY and DONALD H. MENZEL (introduced by Harlow Shapley). Observations show that certain permitted multiplets of O III and N III are not completely represented in the spectra of gaseous nebulae. Some mechanism apparently acts to give selective excitation of some levels of a term without exciting the other levels. Bowen attributes the phenomenon to resonance absorption, principally of the ultimate line of He II, which happens to coincide with an ultimate line of O III. Certain questions and consequences of Bowen's mechanism are discussed. Another method of excitation of fractional multiplets, by direct electron capture by an ion in the ground level of a term (e.g., $^2P_{\frac{1}{2}}$ of O IV), is examined. The components predicted by quantum mechanics do not, however, agree with those observed in the nebulae. The conclusion is reached that Bowen is probably right, although a few discrepancies still remain unexplained. His method apparently requires inelastic electron impacts to be sufficiently frequent to maintain approximately a thermodynamic-equilibrium population of atoms in the levels of the ground term.

The coronaviser, an instrument for observing the solar corona in full sunlight: A. M. SKELLETT (introduced by F. B. Jewett). Special television apparatus has been developed to scan the region of the sky around the sun, to separate the component of the photoelectric current arising from the glare (mainly a d–c. component) from that arising from the scanning of the coronal features (mainly an a–c. component), and to amplify the latter component and to reproduce therefrom an image of the corona. The scanning follows a spiral path. The input

scanner is mechanical and works on the image at the focus of the 15-inch horizontal refractor of the Cook Observatory at Wynnewood, Pa. The reproduction is effected entirely by electrical means and appears on the screen of a cathode ray tube. Numerous images of prominences have been obtained, and a number of the images showed features that apparently were of coronal origin. On one particularly clear day a bright jet or flare in the corona was photographed a number of times over a period of several hours. This feature turned about the optic axis of the telescope with time at the correct rate for a coronal feature.

Southern clusters and galaxies: HARLOW SHAPLEY and JOHN S. PARASKEVOPOULOS. In reporting on the work of the galactic bureau at the Harvard Observatory the following specific projects and objects in the Southern Hemisphere will be discussed: (1) A photometric survey of two new groups of galaxies, each involving many hundreds of individual systems. Distances and dimensions of these supersystems will be estimated, and the luminosity law (distribution of brightness) will be evaluated. (2) Two spirals without nuclei, both large and one possibly within the local supergalaxy. (3) A new "Magellanic Cloud" in Cetus, possibly a member of the local group of galaxies also. (4) The distribution of the periods of classical Cepheid variables in the Magellanic Clouds. The peculiar concentration of the longer periods to regions of higher frequency of stars suggests that we may have in this newly found phenomenon an indicator of the distribution of potential throughout a galaxy.

The Egyptian picture of the sky: O. NEUGEBAUER (introduced by C. A. Kraus). Egyptian and Babylonian astronomy are usually quoted as equivalent foundations for Greek, and therefore medieval and modern, astronomy. But in spite of this fact only very little was known about Egyptian astronomy. Since Brugsch published in 1883 his fundamental collection of different inscriptions of an astronomical character, detailed studies on the history of astronomical concepts in Egypt have been made in only two fields, namely Borchardt's investigations on Egyptian sundials and waterclocks and Pogo's studies on the so-called Decan-starlists on coffin lids belonging to the period *ca.* 2000 B.C. This situation is the more remarkable because in the meantime the impressive structure of the Babylonian theoretical astronomy has become more and more unveiled, showing clearly that Greek astronomy was based on Babylonian knowledge, leaving practically no space for an Egyptian influence. This situation has now, in the meantime, become understandable by the investigation of different Demotic astronomical texts, showing that the Egyptian methods of treating the moon-phenomena and the movement of the planets were only very approximate and without any consideration of details. This picture of Egyptian astronomy is now completed by a Demotic text recently purchased by the Egyptological Institute in Copenhagen, which shows us how the aspect of the sky, the setting and rising of the stars, was connected with religious myths. This text explains the famous picture of the star-goddess Nut, who is represented as bending over the earth, touching with her feet and hands respectively the eastern and western borders of the earth. We learn from this text how the Egyptians interpreted mythologically the invisibility of shifting groups of stars, and how the discovery that this invisibility of stars is merely due to the vicinity of the sun deeply influenced these religious concepts. On the other hand, the close connection of religion, especially as far as the underworld is concerned, with the changing aspect of the sky during the year explains that the main interest of Egyptian astronomy was not a mathematically detailed description of very complex effects, but merely a rough scheme, just good enough to reflect the main traces of the observed facts.

On the decomposition of transitive permutation groups generated by the symmetric group: J. S. FRAME (introduced by C. A. Kraus). Every subgroup H of the symmetric group G of degree n generates a transitive permutation group G_H on the cosets HS_i of G with respect to H, which orders to an element R of G the permutation $HS_i \rightarrow HS_iR = HS_j$. If we restrict R to the elements of H, the cosets which are then permuted among themselves will form aggregates HS_iH called double cosets. Now if G_H is written as a group of permutation matrices and completely reduced, the sum of the squares of the multiplicities of the irreducible components is equal to the number of double cosets HS_iH. We show in this paper that the number of self-inverse double cosets, with respect to a subgroup H of G which is the direct product of symmetric groups, is equal to the sum of the multiplicities of the irreducible components of G_H. In the proof the double cosets are displayed in a series of squares each having a side equal to the multiplicity of an irreducible component of G_H and having inverse double cosets symmetrically placed with respect to the diagonal. This generalizes a diagram of G. deB. Robinson in a recent paper "On the Representations of the Symmetric Group," in which the elements themselves (double cosets with respect to the identity subgroup) are similarly displayed. Use is made of the theory of lattice permutations introduced by P. A. MacMahon and developed by D. E. Littlewood, A. R. Richardson and G. deB. Robinson.

On drawings composed of uniform straight lines: G. D. BIRKHOFF. The question considered is a curious one, dealing with the kinds of drawings in the plane which can be made by a pen or pencil which makes many uniform rectilinear strokes of very narrow width. For instance, the depth of blackness may vary inversely as the distance from a fixed point, tending from black through diminishing grayness towards whiteness at remote points. The mathematics involved leads to a generalization of an integral equation, due to Abel.

A new method in statistical mechanics: NORBERT WIENER and BROCKWAY McMILLAN. The authors integrate the differential equations of motion of a system of similar particles acted on by central forces in such a way as to give symmetric functions of these particles in terms of the time and of symmetric functions of the initial positions and velocities of the system. They then introduce a process of averaging with respect to the initial

rameters which gives the averages of the symmetric functions in terms of the time alone. Finally they let the time become infinite and obtain asymptotic values of these averages. In this way they arrive at the equation of state of a gas. Similar methods can be used for liquids.

Respiratory metabolism of mammalian eggs and embryos: EDGAR J. BOELL and JOHN S. NICHOLAS (introduced by L. L. Woodruff). The respiratory metabolism of rat eggs and embryos during the earliest stages of development has been measured by means of a micromanometer based on the principle of the Cartesian diver in an attempt to discover possible relationships between morphological development and physiological activity. The delicacy of the method can be appreciated by the fact that the oxygen consumption of as few as six to ten eggs, corresponding to a dry weight of approximately 0.0002 milligram, can be measured with a fair degree of accuracy. The eggs were obtained by excising the oviducts of fertilized females at definite intervals after copulation. The oviducts, when cut into small pieces, extrude the ova by peristaltic activity. The embryos were obtained, by surgically freeing them from associated maternal and extra-embryonic structures within the uterus. The preparation of eggs and embryos for respiratory studies was performed under approximately sterile conditions, and, as a rule, approximately one hour elapsed between the administration of anesthetic and the beginning of readings of respiration. The oxygen consumption averages 0.00073 cu mm per egg per hour. No significant differences have thus far appeared in the respiration of one-cell and eight-cell eggs, for development at this time involves merely the division of the egg into a number of smaller units with no perceptible increase in the actual mass of respiring material. When embryonic growth occurs, the oxygen consumed accurately reflects the increase in embryonic mass. On the eighth day of development the oxygen used per embryo amounts to approximately 0.01 cu mm per hour, and during the next two days, during which embryonic organization occurs, this figure is increased twenty times. The influence of various metabolites on the maintenance of embryonic respiration *in vitro* suggests that carbohydrate is easily utilized as a primary energy source during early mammalian development.

The eye in relation to chromatophoral color changes in animals: G. H. PARKER. As a rule fishes with only one eye respond by color changes to differences in their environment as successfully as do those with two eyes. In this respect the trout has long been known to be peculiar, for on the loss of one eye it darkens contralaterally. The common catfish, *Ameiurus nebulosus*, when deprived of one eye conforms neither to the general rule for fishes nor to the special one for the trout. A one-eyed catfish is at first very dark, after which it may change slowly in tint according to its environment, though without ever becoming fully pale. Such fishes may finally assume in the same environment somewhat different tints and retain these with considerable individual persistence. This diversity appears not to be due to variations in the irritability of the orbital wound which might influence to various degrees the stumps of the optic nerve. The

cause of these more or less characteristic color differences is unknown. In these respects one-eyed catfishes are unlike any other fish thus far described. The fact that intermedin, the secretion from the pituitary gland, plays a very important part in the color changes in catfishes and that in this fish chromatophoral nerves, both dispersing and concentrating, are less significant than the pituitary gland, may be the occasion of the difference between Ameiurus and most other teleosts whose chromatophores are often under almost exclusively nervous control.

The effect of dissolved substances on regeneration in Planaria maculata: J. WALTER WILSON (introduced by W. S. Hunter). Flatworms with heads removed by a transverse cut and placed in four fifths Ringer's fluid, fail to close the wound but regenerate a head by producing two lateral half heads, which are later united by a bridge of tissue which grows forward ventral to the wound. The result is a head, at first notched at the tip, but later normal in shape, with an open wound just behind the eyes. This is of interest because of its bearing on three problems: (1) wound closure; (2) source of the cells of the blastema; (3) origin of organization in the blastema. The following experiments were performed in an attempt to discover how the four fifths Ringer's fluid acts: Worms were cut transversely and permitted to regenerate. (1) In six tenths-, seven tenths-, and eight tenths-Ringer's fluid. The wound closed in some worms in seven tenths and most of them in six tenths. Previous experiments had shown that closure occurs in all lower concentrations. (2) In similar solutions after three days in the same concentrations. This exposure previous to the cut did not change the result. (3) In separate solutions containing the individual salts of Ringer's fluid in concentrations that they occur in the four fifths. (4) In four fifths Ringer with KCl, $CaCl_2$ or both left out, and also with KCl, $CaCl_2$ or both doubled. (5) In glucose solution isosmotic with four fifths Ringer's fluid. In all solutions approximately isosmotic with four fifths Ringer's fluid, the wounds failed to close and, if the worms lived, regeneration like that in the four fifths Ringer's fluid occurred. In all more dilute solutions the wounds closed and regeneration occurred as in water unless the solution proved toxic. It is concluded that the effect is due to the osmotic pressure of the solution and not to its chemical nature. It is suggested that it is produced because the isotonic solutions have a weaker stimulating effect on the exposed tissues than the more dilute solutions and water.

Effect of induced polyploidy on doubleness and flecking in flowers of Portulaca grandiflora: A. F. BLAKESLEE and H. E. WARMKE. In *Portulaca* the gene for double flowers (D) is dominant to the gene for singles (d). Full doubles (D_2) do not set seed; semi-doubles (Dd), however, are fully fertile. In diploids there are two types of doubles (D_2 and Dd); in tetraploids there may be four. The two new double types are D_3d and Dd_3. The homozygous tetraploid (D_4) corresponds to the homozygous diploid (D_2) and does not set seed. The tetraploid D_3d type is fertile. The tetraploid D_2d_2 corresponds in double-

ness to the diploid Dd. The tetraploid Dd$_3$ has flowers with at most only a few extra petals. If segregation is in accord with random assortment of 4 chromosomes the plant-breeder could guarantee that all the seeds from selfing a D$_3$d parent would be high-grade doubles. If segregation followed random assortment of 8 chromatids, there should be not over 0.13 per cent. singles. In certain races, red flecks occur on white flowers, due to dominant somatic mutations. In diploids the number of flecks per petal is from 2 to 6 times as frequent as in what appears to be comparable tetraploid material. Since there are twice as many chromosomes per cell in tetraploids one would expect twice as many mutations leading to an increased number of flecks per flower. This appears not to be the case, even if account is taken of the fact that there are slightly fewer cells per tetraploid flower. Our present interpretation is that tetraploidy in some way reduces the mutation rate in individual chromosomes.

The genera of the Boletaceae: WALTER H. SNELL (introduced by Charles Thom). The classification of the Boletaceae most widely accepted in Europe and America has contained four genera: *Strobilomyces, Boletinus, Boletus* and *Gyrodon,* with *Boletus* containing all but 14 of the species arranged in 13 subgroups. The genera and the subgroups of *Boletus* are separated on the basis of gross morphological features of the carpophore. Some of the subgroups of *Boletus* as now constituted differ more from one another than *Boletus* does from the other genera, especially *Boletinus.* In the belief that spore characters are more fundamental as a basis for classification and that the use of them will provide a more natural and usable arrangement of the species in this family, it is proposed to adopt the scheme of Gilbert with certain modifications and made up as follows: subfamily Boleteae, with smooth spores containing the following genera— *Phylloporus, Boletinellus* (a segregate from *Boletinus*), *Boletinus, Ixocomus* (the present Viscipelles), *Pulveroboletus* (the Pulverulenti), *Xerocomus* (the present Subpruinosi and Subtomentosi), *Boletus* (including the Calopodes, Edules and Luridi), *Tylopilus* (the Hyporhodii), *Trachypus* (the Versipelles), *Porphyrellus* (containing two pilose, reddish-spored species), *Gyroporus* (the Cariosi), *Gyrodon,* and a new genus for three species

with very small spores; subfamily Strobilomyceteae, ornamented spores, containing the genera *Strobilom* (with globose, reticulate spores), *Boletellus* (with elliptical spores longitudinally striated or ver spores), and *Polyporoletus* (with spherical, spores).

Cytogenetic strains in certain species of gra GEORGE L. CHURCH (introduced by Charles Thom). studies correlating polyploidy with species differentia and geographic distribution in three genera of gra some cases of cytological differences are found within limits of the species. Most of the forms of *Spart* *patens* (Ait.) Muhl. are hexaploids, as well as two al varieties that are usually recognized as distinct spe *i.e., Spartina caespitosa* A. A. Eaton and *Spartina b* Merr. However, a tetraploid form is occasionally to in Massachusetts and a tall, robust, octoploid typ reported from Florida. Coastal specimens of *Spart* *pectinata* Link. are hexaploid, but a Nebraska strai dodecaploid. It is thought that in New England the h ploid *S. caespitosa* could arise as a cross between *S.* *tinata* and *S. patens.* The early-flowering, strand for of *Spartina alterniflora* Lois. are octoploid, while taller, robust, late-flowering forms of tidal lagoons decaploid. The widely distributed *Panicum virgatu* is tetraploid, but a smaller strain with pilose leaves fr Oklahoma is octoploid. The latter occurred in a plant of a large tetraploid strain. In the genus *Andropog* western strains of *A. haillii* Hack. and *A. provinci* Lam. are hexaploid, but specimens with an extra m ploid complement are found. The lack of polyploidy the southern strains of *A. virginicus* L. thus far stud is attributed to the fact that the probable parents, typ *A. virginicus* L. and *A. glomeratus* (Walt.) B.S.P. both diploids.

Biographical memoir of Julius Stieglitz: W. A. No
Biographical memoir of Graham Lusk: E. F. DuBois
Biographical memoir of Elihu Thomson: K. T. Compt
Biographical memoir of Ernest William Brown: Fr SCHLESINGER and DIRK BROUWER.

Biographical memoir of George Ellery Hale: WALTE ADAMS.

SCIENTIFIC EVENTS

THE EXPOSITION OF CHEMICAL INDUSTRIES

THE seventeenth Exposition of Chemical Industries will be held at Grand Central Palace, New York, from December 4 to 9. Three floors have been reserved for the exhibit, and nearly 300 exhibitors, representing over forty industries, have engaged space.

Chemicals, chemical raw materials and fabricated materials will be shown in terms of their manufacture and use. One exhibit will be devoted to carbon monoxide and its use as a reagent in educational, industrial and commercial laboratories. In the field of drying agents a soluble anhydride, the result of research on

the fundamental nature and behavior of hydrates calcium sulfate, will be demonstrated. Applicatio range from refrigeration to the drying of cable spli in the telephone and telegraph industries, also a r large-scale process for the dehydration of serums fr the frozen state.

Materials of construction will include acid and c rosion proof linings for tanks, towers, process equ ment, also for electrolytic refining tanks and for a water and oil-proof linings which will be demonstrat in their uses for pickling tanks and acid dispo equipment, also for electrolytic refining tanks, and f acid sludge in petroleum refineries.

he field of precision instruments will include the
. . . st types of temperature and pressure measuring
. . . ices. There will be a vibration proof potentiometer
. . . troller, a recorder controller pyrometer for throt-
. . . g fuel heat and a new line of rectangular-case indi-
. . . ng recorders and controllers with nine-, ten- and
. . . lve-inch charts for temperature and pressure.
. . . er instruments of precision will include a machine
. . . determine plasticity. Measurement by this instru-
. . . nt is said to provide an accurate index to changes
. . . the material caused by different temperatures, addi-
. . . n of ingredients or fillers, breakdown action of
. . . alysts, etc. A new recording viscosimeter offers a
. . . ral drive thermometer, the first of its kind to be
. . . nufactured, which governs a constant speed tem-
. . . rature increase of the suspension to be measured.
. . . One exhibit will display meters for measuring and
. . . egrating accurately the quantity of liquids passed
. . . rough closed pipes—to permit knowledge of the cost
. . . liquids metered, to facilitate control of the use of
. . . uids and to assure accurate manufacture of prod-
. . . ts containing a liquid.

There will be a complete range of process equip-
. . . ent, including steam jacketed kettles and tanks, made
. . . om stainless steel, monel metal and pure nickel.
. . . ass-lined steel equipment will be demonstrated, and
. . . pecially acid-resistant units will be offered for high-
. . . ressure work.

HE TROPICAL FLOWER GARDEN OF THE NEW YORK BOTANICAL GARDEN

A NEW tropical flower garden in the main conserva-
. . . ries at the New York Botanical Garden will be opened
. . . the public on the week-end of November 4. Members
. . . the garden will attend a formal opening in a brief
. . . remony the preceding afternoon; on Saturday morn-
. . . g the public will have its first view of the completed
. . . arden, which, with the rest of the greenhouse, will be
. . . pen daily without charge from 10 to 4.

Taking part in the ceremony will be Dr. William J.
. . . obbins, director; Allyn R. Jennings, general super-
. . . ntendent of parks; Colonel Robert H. Montgomery,
. . . epresenting the board of managers of the garden,
. . . nd Mrs. Elon Huntington Hooker, president of the
. . . dvisory council.

The occasion will also mark the opening of the in-
. . . oor floral displays for the 1939–40 season. These
. . . isplays, in which from two to five thousand pots of
. . . lowering and foliage plants are used at a time, have
. . . rought nearly half a million people to the garden
. . . since the newly rebuilt conservatory range was opened
. . . less than a year ago.

The new tropical flower garden, which is one of
. . . fifteen units in the conservatory range, contains many
. . . plants with which travelers in the tropics are familiar,
. . . and also decorative plants which are rarely seen either
. . . in southern regions where they would grow outdoors or

in northern conservatories. A few are cultivated only
at the New York Botanical Garden.

The tropical flower garden is the tenth specially
planted house to be opened since the large greenhouse
was rebuilt by the city during 1937 and 1938. First
to be seen in their new quarters were the cacti and
other succulent plants which are natives of the great
deserts of the world. The Botanical Garden has more
than 2,000 different kinds, the true cacti in one house,
the other New World succulents (which are plants with
fleshy leaves or stems) in another, and the succulents
of the Old World in a third.

Last year at Christmas time a tropical rain forest
house was opened, and adjoining it a tropical fern
house, both naturalistically planted. A special house,
which was opened in the spring, contains plants of the
Aroid family, including the spectacular genus Amor-
phophallus, one of whose members bears the flower
known as the largest in the world. Adjoining it is the
aquatic house, where a specimen of the royal water-
lily, *Victoria regia*, now is in bloom. Other houses,
containing palms, economic plants, begonias and other
subjects, are open to the public, although the planting
arrangement in them is not yet complete.

REORGANIZATION OF LABORATORY DIRECTORS' CONFERENCE

A REORGANIZATION of the Conference of State Lab-
oratory Directors was effected at its nineteenth annual
meeting in Pittsburgh on October 16, when a constitu-
tion and by-laws were adopted changing the name and
expanding the organization into a Conference of State
and Provincial Public Health Laboratory Directors
with full membership privileges limited to directors of
official state and provincial public health laboratories.
The committee on reorganization which proposed the
constitutional changes was composed of the following
members representing laboratories widely scattered
geographically throughout the United States and
Canada: E. M. Bramhall, Utah; L. F. Ey, Ohio; M. H.
McCrady, Quebec; Dr. C. A. Perry, Maryland; Dr.
E. S. Robinson, Massachusetts; Dr. T. F. Sellers,
Georgia; Dr. H. J. Shaughnessy, Illinois; Dr. A. B.
Wadsworth, New York, and Dr. Friend Lee Mickle,
Connecticut, *chairman*.

Associate membership was made available to the re-
sponsible assistants of directors of state and provincial
laboratories and to the directors and responsible assis-
tants in municipal and other official public health lab-
oratories in the two countries.

In the newly adopted constitution it is stated that
the purposes and objects of the conference shall be to
promote the development, improvement and effective-
ness of public health laboratory service; to coordinate
public health laboratory activities; to stimulate the
interchange of experience among directors of official
public health laboratories; to develop and maintain

adequate standards for the professional training of public health laboratory personnel; to encourage constant effort toward the improvement and standardization of technical methods; to collect and make accessible to all persons in official administrative positions in public health laboratories such information and data as might be of assistance to them in the proper fulfilment of their duties.

It is proposed in the by-laws that the conference continue to meet annually at the place of the annual meeting of the American Public Health Association on the day preceding the opening date. Scientific and business meetings open to the entire membership have been provided for, as well as executive sessions limited to full members for action on matters of policy affecting state or provincial public health laboratories. The conference will continue issuing annually a mimeographed volume of proceedings which will be furnished to members and sold to others as in the past.

The officers and councilors elected for 1939-40, all directors of state laboratories, are: *Chairman*, Dr. Friend Lee Mickle, Connecticut; *Vice-chairman*, L. F. Ey, Ohio; *Secretary-Treasurer*, Miss K. E. Cox, West Virginia; *Councilors*, Dr. T. F. Sellers, Georgia, and Dr. E. S. Robinson, Massachusetts.

IN HONOR OF DR. EVARTS AMBROSE GRAHAM

THE former and present pupils and associates of Dr. Evarts Ambrose Graham, Bixby professor of surgery at Washington University, Saint Louis, celebrated recently the twentieth anniversary of his professorship. Scientific sessions were held on October 11 and 12, and a dinner in his honor was given on the night of the twelfth.

At this dinner public tributes were given by Dr. Philip A. Shaffer, dean of the department of medicine at Washington University; Dr. Allen O. Whipple, professor of surgery, Columbia University, and president of the American Surgical Association; Dr. J. A. Hayden, of Melbourne, Australia, and by Dr. Malvern B. Clopton, clinical professor of surgery of Washington University and president of the corporation of this institution.

In addition to the presentation of a scrapbook and silver, there was announced the establishment of the Graham Lectureship to be given annually in Saint Louis. Dr. Graham received tributes by letter and telegram from all over the world. There were present about forty-five of his former pupils from scattered points. Several guests expected from abroad were prevented from attending by the war. An abstract of the proceedings is to be published in *Surgery*.

NOMINATIONS FOR PRESIDENT-ELECT OF THE AMERICAN CHEMICAL SOCIETY

LOCAL sections of the American Chemical Society have proposed for nomination for president-elect the following members:

H. S. Booth, professor of chemistry, Western Reserve University.

Sidney M. Caldwell, director of Development Division, Tire Department, U. S. Rubber Company.

William Mansfield Clark, professor of physiological chemistry, the Johns Hopkins University.

M. L. Crossley, director of research, the Calco Chemical Company, Bound Brook, N. J.

Gustavus J. Esselen, president and treasurer, Gustavus J. Esselen, Inc.

William Lloyd Evans, professor of chemistry and chairman, the Ohio State University.

Francis C. Frary, director of research, Aluminum Company of America.

Per K. Frolich, director of the Chemical Laboratories, The Standard Oil Development Company.

Harry N. Holmes, professor of chemistry and head of the department at Oberlin College.

Henry G. Knight, since 1927 chief of the Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture.

Townes R. Leigh, acting vice-president of the College of Arts and Sciences, University of Florida.

R. E. Swain, head of the department of chemistry, Stanford University.

Floyd E. Bartell, professor of chemistry, the University of Michigan.

RECENT DEATHS AND MEMORIALS

DR. MARGARET FLOY WASHBURN, professor emeritus of psychology at Vassar College, died on October 2..., at the age of sixty-eight years.

HENRY CLAY ANDERSON, dean of the College of Engineering of the University of Michigan, died on October 14 at the age of sixty-six years.

PROFESSOR WILLIAM JORDAN SWEETSER, since 1915 head of the department of mechanical engineering at the University of Maine, died on October 15. He was sixty-five years old.

DR. RODOLPHO VON IHERING died in São Paulo, Brazil, on September 15, at the age of 56 years. At the time of his death he was chief of the Serviço Federal de Piscicultura, Rio de Janeiro.

R. S. TROUP, professor of forestry in the University of Oxford and fellow of St. Johns College, from 1924 to 1935 director of the Imperial Forestry Institute, died on October 1, aged sixty-four years.

DR. G. M. MURRAY, emeritus professor of medicine in the Victoria University of Manchester, known for his work on diseases of the thyroid gland, died on September 21.

DR. EDOUARD BUGNION, professor emeritus of the Medical Faculty and the University Faculty of Lausanne, died on July 4 in his ninety-fourth year. He was known for his work on the anatomy and histology of invertebrates.

PROFESSOR GIULÏO SIROVICH, professor of chemistry in the University of Rome and director of the National Institute of Metallurgical Chemistry, was killed in an automobile accident on October 4.

A MEMORIAL meeting in honor of the late Dean Herman Schneider, of the University of Cincinnati, founder of the plan of cooperative technical education, will be held at the University of Cincinnati on November 5. President Raymond Walters will preside, and addresses will be made by Dr. Charles F. Kettering, vice-president of the General Motors Corporation; Dr. Parke R. Kolbe, president of the Drexel Institute of Technology, Philadelphia, Pa., and Dr. Frank W. Chandler, professor of English and comparative literature in the College of Liberal Arts.

SCIENTIFIC NOTES AND NEWS

THE Nobel Prize for physiology and medicine for 1939 has been awarded to Dr. Gerhard Domagk, of the German I. G. Farbenindustrie, in recognition of his work with protonsil, forerunner of sulfanilamide and similar chemical compounds for the treatment of streptococcus infections. The prize for 1938, which was held over from 1938, has been awarded to Dr. Corneille Heymans, professor of pharmaco-dynamics at the University of Ghent, Belgium, in recognition of his work on the sinus aorta mechanism in breathing. Dr. Domagk is reported to be awaiting the approval of the German Government before accepting the prize.

DR. EDWARD A. DOISY, professor of biological chemistry and director of the department of the School of Medicine of the St. Louis University, received the seventh annual St. Louis Award, at a public ceremony held in the mayor's office on October 26. The award, $1,000 and a certificate, is the gift of an anonymous donor. The certificate states that Dr. Doisy was chosen: "For his brilliant investigations and research which resulted in the discovery, isolation and synthesis of the vitamin that checks hemorrhage."

THE Perkin Medal, given annually by the Society of Chemical Industry for "valuable work in applied chemistry," has been awarded to Dr. Charles M. A. Stine, vice-president in charge of research of E. I. du Pont de Nemours and Company. The Chemical Industry Medal has been awarded to Dr. Robert E. Wilson, president of the Pan American Petroleum and Transport Company.

THE annual Progress Medal of the Society of Motion Picture Engineers was presented on October 18 at the semi-annual dinner to Dr. Loyd A. Jones, since 1916 chief physicist of the laboratories of the Eastman Kodak Company, in recognition of his contributions to motion picture technology.

THE Franklin Institute of the State of Pennsylvania has made its first award of the Vermilye Medal "in recognition of outstanding contribution in the field of industrial management" to Lewis H. Brown, president of the Johns-Manville Corporation, New York. Presentation of the medal will be made in Philadelphia on November 14. It is named after its donor, William M. Vermilye, vice-president of the National City Bank of New York.

AT the graduation ceremony of the University of St. Andrews on October 6 the honorary degree of doctor of laws was conferred on Dr. Alexander Mackenzie, from 1914 until his retirement with the title emeritus in 1938 professor of chemistry in University College, Dundee.

THE Chicago Branch of the American Association of Scientific Workers at its October meeting elected the following officers and members of the executive committee: Professor Arthur H. Compton, *chairman;* Dr. Zelma Baker, *secretary-treasurer;* Professor Anton J. Carlson, Dr. Ralph W. Gerard, Dr. Victor E. Johnson and Dr. Benjamin F. Miller, *members.*

DR. LOUIS M. MASSEY, professor of plant pathology at Cornell University, was elected president of the American Rose Society at the recent Brooklyn meeting.

DR. P. S. BURGESS has returned as dean of the College of Agriculture of the University of Arizona and director of the Experiment Station, after spending a year in a similar capacity at the Rhode Island College. Dr. R. S. Hawkins, who has served as acting dean and acting director, has been appointed vice-dean and vice-director in addition to reassuming his position as head of the department of agronomy.

DR. WILLARD M. ALLEN, associate professor of obstetrics and gynecology at the Medical School of the University of Rochester, New York, has been appointed professor of obstetrics and gynecology in the Medical School of Washington University, St. Louis. Dr. Otto H. Schwarz, who for eleven years has been head of the department, has expressed his desire to be relieved of the administrative responsibilities of the conduct of the department in order that he may have time to engage in consulting practice.

Nature states that W. C. Wilson, director of the unit for clinical research in surgery at Edinburgh Royal Infirmary, has been appointed regius professor of surgery in the University of Edinburgh.

DR. M. J. MURRAY, head of the department of chemistry, and Dr. Forrest F. Cleveland, head of the departments of physics and mathematics of Lynchburg College, have been appointed to assistant professorships of chemistry and physics, respectively, at the Armour Institute of Technology, Chicago. They will continue their joint research on the Raman effect and molecular structure.

DR. ALFRED BLALOCK, professor of surgery, Vanderbilt University School of Medicine, and Dr. Homer W. Smith, professor of physiology in the New York University College of Medicine, have been appointed members of the Medical Fellowship Board of the National Research Council for the period ending June 30, 1941.

PROFESSOR GEORGE ERLE BEGGS, of Princeton University, has been elected chairman of the Engineering Foundation. Dr. O. E. Buckley, executive vice-president of the Bell Telephone Laboratories, New York, has been elected vice-president; Otis E. Hovey has been reelected director, and John H. R. Arms has been reelected secretary.

DR. ESMOND R. LONG, director of the Phipps Institute, Philadelphia, has been elected a member of the Medical Research Committee and of the Committee on Standards of Undergraduate Education of the National Tuberculosis Association.

RICHARD W. JACKSON, associate professor of biochemistry at the Cornell University Medical College, has been appointed chief of the Protein Division of the Eastern Regional Research Laboratory at Wyndmoor, Pa., of the U. S. Department of Agriculture, where he will be in charge of research on the isolation and properties of proteins available from agricultural products.

PARKE, DAVIS AND COMPANY have renewed their fellowships on Cascara and Vitamin C in the department of chemistry of the University of Pittsburgh. Robert W. Liddell, of the University of Pittsburgh, has been reappointed fellow, and Kenneth A. Kuiken has been appointed Vitamin C fellow. The Abbott Laboratories, Incorporated, also have provided a Vitamin C fellowship, to which Howard H. Fricke, of Washington State College, has been appointed. Dr. C. G. King, professor of biochemistry, is directing the researches.

DR. GEORGE L. McNEW, fellow at the Rockefeller Institute for Medical Research, Princeton, N. J., has been appointed chief of research in plant pathology at the New York State Agricultural Experiment Station.

LEONARD J. GOSS, pathologist for the department of animal pathology of the Kentucky Agricultural Experiment Station, has been appointed veterinarian at the New York Zoological Park.

ACCORDING to *Nature* Professor Kanichi Terazawa, dean of the faculty of science of Tokyo Imperial University, has succeeded Professor Mishio Ishimoto as director of the Earthquake Research Institute. Professor Ishimoto will continue his work as a member of the institute.

DR. MORTIER F. BARRUS, professor of plant pathology at Cornell University, sailed on September 29 for Venezuela to organize extension workers there and to help to overcome plant disease problems. Dr. Carlos S. Chardon, formerly president of the University of Puerto Rico, is one of his co-workers.

THE Medical Aid Committee for Spanish Refugees announces that under its auspices Dr. Emilio Mira, professor of psychiatry in the faculty of medicine of the University of Barcelona, will spend two weeks in the United States prior to taking up his work as director of mental hygiene for the Cuban Government.

DR. C. A. ELVEHJEM, professor of biochemistry at the College of Agriculture of the University of Wisconsin, will deliver the second Harvey Society lecture of the current series at the New York Academy of Medicine on November 16. He will speak on "The Biological Significance of Nicotinic Acid."

DR. EDWARD R. WEIDLEIN, director of the Mellon Institute of Industrial Research, gave the principal address at the dedication of the Paul Mellon Science Hall of the Choate School at Wallingford, Conn. The building is the gift of Paul Mellon, son of the late Andrew W. Mellon.

DR. GEORGE B. CRESSEY, of Syracuse University, gave on October 25 an illustrated lecture on "China, Its Natural Resources and Their Significance" before the Smith College Chapter of Sigma Xi. During the afternoon he spoke to the members of the Department of Geology on "Pioneering in Siberia."

DR. ERNEST W. GOODPASTURE, professor of pathology at the Vanderbilt University School of Medicine, Nashville, gave a series of lectures before the Portland Academy of Medicine from October 23 to 25. His subjects were "Investigations of Virus Infections and Immunity by Means of Chick Embryo Technic"; "Experimental Bacterial Infections of the Chick Embryo" and "A Consideration of Pathogenesis of Virus and Bacterial Infection, with a Review of Some Virus Diseases."

SPEAKERS at the ninth annual Forum on Current Problems of *The New York Herald Tribune* included Dr. James Bryant Conant, president of Harvard University; Dr. Arthur H. Compton, professor of physics at the University of Chicago; George Washington Carver, professor of chemistry at Tuskegee Institute; Dr. Perrin H. Long, associate professor of medicine

the Johns Hopkins University; Dr. Foster Kennedy, professor of neurology at Cornell University Medical College, and Dr. Francis Carter Wood, director of the Crocker Institute for Cancer Research, Columbia University.

DR. HARLOW SHAPLEY, Dr. Otto Glasser and Dr. Paul B. Sears are among the speakers announced by Cooper Union, New York City, in a series of lectures entitled "Adventures in Ideas" extending from October to April. They speak in the Sunday evening series, which will be held each week, with the exception of December 24 and 31, at 8:00 P.M., and which will be broadcast over station WQXR.

FELLOWSHIPS in the medical sciences, administered by the Medical Fellowship Board of the National Research Council, of which Dr. Francis G. Blake, of Yale University, is chairman, will be available for the year beginning July 1. These fellowships are open to citizens of the United States or Canada who possess an M.D. or a Ph.D. degree. They are intended for recent graduates and not for those already professionally established. Fellows will be appointed at a meeting of the board about March 1. Applications to receive consideration must be filed on or before January 1, 1940. Appointments may begin on any date determined by the board. For further particulars concerning these fellowships, address the Secretary of the Medical Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington, D. C.

THE National Association of Manufacturers is planning to extend specific recognition to science, in the form of awards to "outstanding contemporary scientists who will be selected as modern pioneers." The first occasion on which these awards will be bestowed is at the celebration of the one hundred and fiftieth anniversary of the American Patent System in February 27. Dr. Karl T. Compton, president of Massachusetts Institute of Technology, has been elected chairman of a committee of six scientific men who will make the selection. The other members are Dr. Forest R. Moulton, permanent secretary of the American Association for the Advancement of Science; Dr. George B. Pegram, dean of the Graduate School, Columbia University; Professor John T. Tate, professor of physics and dean of the College of Science, Literature and Art and director of University College of the University of Minnesota; Dr. Edward R. Weidlein, director of the Mellon Institute for Industrial Research, Pittsburgh, and Professor Frank C. Whitmore, research professor of organic chemistry and dean of the School of Chemistry and Physics at the Pennsylvania State College. The association has asked its members and trade groups and scientific societies to send nominations to its offices at 14 West Forty-ninth Street before December 1. A special committee of eighty industrialists has been appointed to promote the search for "modern pioneers." The chairman is Robert L. Lund, executive vice-president of the Lambert Pharmacal Company.

THE twelfth annual Graduate Fortnight of the New York Academy of Medicine was opened on October 23 with an address of welcome by Dr. Malcolm Goodridge, president of the academy. This year the subject discussed is "The Endocrine Glands and Their Disorders." Seven hundred visiting physicians, in addition to the 2,300 fellows of the academy, registered. Twenty-two clinical conferences and demonstrations were arranged to be held in seventeen of the hospitals of New York City, and eight round table conferences have been organized. Ten evening meetings, during which addresses were delivered by twenty-three speakers drawn from the leading universities and research institutions of the United States and Canada, were held, at which the speakers included: Dr. H. M. Evans, director of the Institute of Experimental Biology of the University of California; Dr. J. B. Collip, professor of biochemistry, McGill University; Dr. Elmer L. Sevringhaus, professor of medicine, the University of Wisconsin; Dr. Walter B. Cannon, professor of physiology, Harvard University; Dr. Robert F. Loeb, professor of medicine, Columbia University; Dr. C. N. H. Long, Sterling professor of physiological chemistry, Yale University; Dr. R. T. Woodyatt, clinical professor of medicine, Rush Medical College; Dr. John F. Fulton, Sterling professor of physiology, Yale University; Dr. William G. MacCallum, professor of pathology, the Johns Hopkins University, and Dr. Philip E. Smith, professor of anatomy, Columbia University. The scientific exhibit, which covers many aspects of endocrinology, is in the building of the New York Academy of Medicine.

THE winter meeting of the Industrial Research Institute will be held in Chicago on Friday and Saturday, December 8 and 9. The institute, an affiliate of the National Research Council, has a membership made up of executives who manage scientific research for large and small industries in the United States. Members of the institute will be the guests of Swift and Company at its laboratories on Friday morning and afternoon. The Friday evening and Saturday sessions will be held at the Hotel Stevens.

THE policy to be followed by the Royal Institution during the war has been under consideration by the managers, who have decided to maintain its activities so far as possible. The libraries and reading rooms will be kept open as usual. Although the present lighting restrictions prohibit the holding of the Friday evening meetings, a series of afternoon lectures is being arranged.

THE Royal Society, London, will function normally

during the war; the administrative office has been moved to Trinity College, Cambridge, and it is probable that the meetings of the society will be held in that town.

THE celebration of the centenary of the Royal Microscopical Society in October has been postponed. It may be found necessary for the time being to curtail the number of ordinary meetings normally held in London during the session. Arrangements are being made to continue publication of the society's journal as usual.

THE new mechanical parts plant of the Spencer Lens Company was opened formally on October 26. The operations of each department were demonstrated, and there was an exhibit of scientific optical instruments.

DISCUSSION

THE WAR AND CHRONICA BOTANICA

THE impact of the European war on science has already been felt in the United States through the cancellation of foreign subscriptions to American scientific journals and to services like *Biological Abstracts*. The same is true in other neutral nations as well as among the belligerents, no doubt. An obligation rests upon every scientific society and association in this country to consider the effects of the war situation and to join forces in preserving, as far as may be possible, essential scientific publishing and abstracting services until normal conditions return.

A colleague permits the writer to quote from a letter from the editor of *Chronica Botanica*, the international plant science news-magazine. The letter is signed by Dr. Frans Verdoorn, who writes in September from Leiden, Holland (Postoffice Box 8) as follows:

The present war which is expected to be a lengthy one makes it impossible for me to continue *Chronica Botanica*. About a fortnight ago my morning mail dropped from about 60 pieces to 12 and hardly any information or money is being received. I can still finish this year's *Chronica* and am doing so, but that will be all. This country of course is neutral and there is a fair chance that it will remain so, but that does not help me much as I am wholly dependent on information and subscriptions from countries now in war, from which I do not hear anything.

My wife and I gave 5 years to building up the *Chronica* and we are in great distress that we should have to stop it. And I will have to do so as the post which I will have to accept under the circumstances in the very near future, is in Java, . . . but one can not do any international work there. It is out of question to continue the *Chronica* there.

I feel, however, that it would be possible to continue the *Chronica* in some form in the States. Even if the States would be involved in a war, I could continue it there with the aid of North and South American editors, and it would still remain self-supporting. But I would need some kind of post for my own living, as—at least during the war— there will be hardly any profits on the *Chronica*. . . .

Even if I had a minor post to start with, I would be able to continue my *Chronica* in the States during the war, and that is the only thing that matters at present.

I am asking this not on behalf of myself, as there are for me personally suitable posts, but on behalf of the *Chronica* which during the past year has become a symbol to its 2,000 readers, a symbol of good will and cooperation, which I am most anxious to continue.

Any suggestions which may disclose possibilities for the continuance of *Chronica Botanica* should be sent immediately to Dr. Frans Verdoorn, Editor, *Chronica Botanica*, P. O. Box 8, Leiden, Holland. Dr. Verdoorn's ability as a plant scientist is widely recognized and the unique editorial services he has rendered to his professional colleagues all over the world through the medium of *Chronica Botanica* are deeply appreciated. It would be a permanent international scientific loss if *Chronica Botanica* should be forced to suspend on account of the war. Is there not a way out?

ROBERT F. GRIGGS

REMARKS ON THE CENTER OF POPULATION

THIS note is written to draw attention to an erroneous statement made at the end of the paper on "Centers of Population of Learned Groups," by C. B. Read.[1]

In the paper referred to the center of a population the n members of which have rectangular coordinates (x_i, y_i), $i = 1, 2, \ldots, n$, is defined as the point with coordinates

$$x = \frac{\Sigma x_i}{n} \qquad\qquad y = \frac{\Sigma y_i}{n}$$

that is, the point (x, y) is the center of gravity of the distribution. A statement is made implying that the sum of the distances of the members from this point is minimum. This is not true in general; (x, y) is the point for which the sum of the *squares* of the distances is minimum.

The distinction is clear in the special case of a population distributed on a straight line. The mean point is the center of population as here defined, while the median, a point such that the same number of members lie on each side of it, has the property that the sum of the distances from it is minimum. These points do not in general coincide; for many distributions the median is between the mean and a point of greatest population density, the mode. As a definite example consider the seven points having coordinates 0, 1, 2, 3,

[1] SCIENCE, 90: 61–63, July 21, 1939.

4, 10, 15. The median is at 3, with the sum of distances 26, while the mean is at 5 with the sum of distances 30.

If a point may be discussed when no direct means for obtaining it are given (at present), a point in the plane of a distribution such that the sum of the distances from it to the members is minimum may be called a median. An example of a triangle consisting of two nearby points and a third point remote from them shows that the median and the center of population do not in general coincide, and the difference can by no means be neglected. The special distribution on a straight line and simple examples of plane distributions make it seem reasonable to believe in the absence of more complete information that the median is frequently closer to the center of greatest population concentration than the center of population is.

RANDOLPH CHURCH

U. S. NAVAL ACADEMY,
ANNAPOLIS, MD.

THE criticism offered by Dr. Church is certainly justified, since the center of population as determined by the method described or by that of the Bureau of the Census does not give the point the sum of whose distances from the stated address of members of the group is a minimum. Without question it should have been clearly pointed out that the points determined are centroids and only roughly satisfy the minimum distance criterion. The actual determination of such points did not seem to be a feasible problem; the centers of population as determined do allow direct comparison with various positions of the center of population of the United States as determined by each federal census, the primary purpose of the study.

A method by which one might attempt to approximate the location of the point Dr. Church calls a median would be to locate what the Census Bureau designates as a "median point," that is, the point of intersection of a north and south line which divides the population into two equal parts, with an east and west line which likewise divides it into two equal parts. For the groups mentioned the median line running east and west is usually from ten to fifty minutes of latitude north of the center of population. The line running north and south may be through the center of population as with the American Speech Correction Society; about a degree and twenty minutes (roughly sixty or seventy miles) east as in the Mathematical Association of America; perhaps three degrees east in the American Association for the Advancement of Science; other groups range from no change to about two and a half degrees east. For exact determination of a mathematical point, these are large variations, but for locating a convention city various factors make the difference relatively unimportant.

Even if one knew the location of the ideal point with sums of straight-line distances of members from this point a minimum, if the problem of a proper place for a convention of the group is involved, air-line distances should be corrected to distances by a regularly traveled route (and, shall this be by rail, bus, plane, private car or steamer?). If this can be determined, there arises the need for some reasonably large city in the vicinity. The relatively small variation of median lines from centers of population make it seem probable that the centers of population determined give a sufficiently accurate general location from the point of view of minimum travel requirements. Such cities as Cincinnati, Columbus and Dayton seem well located; for most groups Chicago is to the northwest and Pittsburgh slightly to the northeast.

C. B. READ

UNIVERSITY OF WICHITA

THE FIRST DATING OF PRESERVED WOOD IN NEW ENGLAND

THE principle of cross-dating wood of unknown age by comparing the sequence of its ring widths with that of an acceptable record of dated rings has not been hitherto applied in the New England area. An opportunity to test the method came in 1938, when the September hurricane felled some virgin white pine not far from Wolfeboro, N. H., where buried logs of the same species were uncovered in an excavation at the site of an ancient bridge abutment. The skeleton plot method of Douglass has given the date of 1806 for the last ring formed in the trees used to build the bridge. This solution is very reasonable in the light of Wolfeboro history.

Sections of three trees were removed from a level several feet below the water line at the bridge. The wood and bark had been very well preserved in the saturated soil. The rings of each tree were measured by methods previously described.[1] The mean ring width was calculated for each of the 153 years represented by at least two trees, while the third tree had 189 rings. The growth was semi-complacent but small minima and maxima in the composite graph, found also in two or more of the individual graphs, were located on the skeleton plot[2] for comparison with the sequence of dated rings.

A record of white pine ring widths for a 260-year period was obtained from three trees at North Sutton, N. H., 39 miles southwest of the bridge at an elevation slightly higher. A cross-identification was established between this record and that of the buried pine when the outer 128 rings of the latter overlapped the inner rings of the Sutton trees. Although not sufficient in

[1] C. J. Lyon, *Ecology*, 17: 457–478, 1936; *Tree-ring Bull.*, 5: 27–30, 1939.
[2] W. S. Glock, "Principles and Methods of Tree-ring Analysis," Part I., Carnegie Institution Pub. 486, 1937.

number to give a standard scale of white pine growth in the area, these Sutton pines gave a record that cross-identified well but not perfectly with nearby white pine records of the period 1867–1934.[3] The presence of 260 rings was notable for white pine and important for the problem because of the wide overlap made possible even with trees buried more than a century.

The accuracy of the cross-identification is shown by the following facts. Of the six wide rings in the buried wood, five checked perfectly with the Sutton pines, while each record for the 128 years showed one maximum not represented in the others. In the same way and for the same 128 years, of the 16 narrow rings in the buried trees, eight checked with lows in the Sutton trees, four checked with years marked by lows in the hemlock record of the Wolfeboro district and by drouths recorded in a diary, two missed agreement with the Sutton record by one year, while only two stand alone.

This relatively unimportant problem demonstrates the possibilities of the method for the area and the extent to which significant narrow and wide rings appear in sensitive trees of the New England area. The cross-identification is apparently less perfect here than in the Southwest, but valid solutions of archeological problems seem possible, particularly when the material includes a long series of rings from a native "softwood" tree.

<div style="text-align:right">CHARLES J. LYON</div>

DARTMOUTH COLLEGE

NOTICE OF POSSIBLE SUSPENSION OF THE RULES OF NOMENCLATURE IN CERTAIN CASES (A.(n.s.) 1)

IN accordance with a resolution adopted by the International Zoological Congress at their ninth meeting held at Monaco in 1913, prescribing that not less than one year's notice is to be given by the International Commission on Zoological Nomenclature of all applications received for the "Suspension of the Rules," the attention of the zoological profession is hereby invited to the fact that requests for the "Suspension of the Rules" have been received by the commission in the undermentioned cases:

(a) ECHINODERMATA.—*Diadema* Humphreys, 1797 (type *Echinometra setosa* Leske, 1778) to be added to the Official List of Generic Names (see Mortensen, 1937, *Ann. Mag. nat. Hist.* (10) 19: 463–469) (reference Z. N. (S.) 52).

(b) INSECTA, Neuroptera.—To be added to the Official List of Generic Names with types as shown in brackets:— *Hemerobius* Linnaeus, 1758 (*Hemerobius humulinus* Linnaeus, 1758); *Chrysopa* Leach, 1815 (*Hemerobius perla* Linnaeus, 1758) (see Cowley and others, 1937, Generic Names of British Insects, Pt. 4) (reference Z. N. (S.) 42).

(c) INSECTA, Lepidoptera.—To be added to the Official List of Generic Names with the type as shown in brackets:—*Actinote* Hübner, [1819] (*Papilio thalia* Linnaeus, 1758) (see Hemming, 1936, *Proc. R. ent. Soc. Lond.* (B) 5: 56–57) (reference Z. N. (S.) 63).

(d) REPTILIA.—*Bitts* Gray, 1942 (type *Vipera* (*Echidna*) *arietans* B. Merrem, 1820), to be added to the Official List of Generic Names, and *Cobra* Laurent, 1768, to be suppressed (Stejneger, 1936, *Copeia*, 3: 140) (reference Z. N. (S.) 121).

In adopting the resolution referred to above, the International Zoological Congress expressly stated that their object was thereby to render it possible for zoologists, particularly specialists in the group in question, to present to the commission arguments for or against the suspension of the rules proposed. Any such representations should be furnished to the Secretariat to the Commission (British Museum (Natural History), Cromwell Road, London, S.W. 7) as soon as possible and in any case within one year of this day's date. Every such communication should be clearly marked with the commission's reference number as given above.

<div style="text-align:right">By ORDER OF THE COMMISSION,
(Signed) FRANCIS HEMMING,
Secretary to the Commission</div>

SECRETARIAT OF THE COMMISSION,
BRITISH MUSEUM (NATURAL HISTORY),
CROMWELL ROAD, LONDON, S.W. 7.
27TH JUNE, 1939

SCIENTIFIC BOOKS

QUANTUM MECHANICS

Introductory Quantum Mechanics. By VLADIMIR ROJANSKY. Prentice-Hall, Inc., New York, 1938. $5.50.

THE current literature of modern physics is of such a character that one can not in general appreciate the arguments without an understanding of the physical ideas, and in many cases the mathematical methods, peculiar to quantum mechanics. Hence it is necessary that a graduate student of pure physics acquire this

[3] L. Goldthwait and C. J. Lyon, *Ecology*, 18: 406–415, 1937.

knowledge early in his career. While the new physical notions can and should be presented in advanced undergraduate courses on the phenomena of modern physics, the mathematical treatment must perhaps in general wait for the fuller experience of graduate study, but should certainly be begun in the first graduate year if the doctorate is to truly represent a maturity of knowledge and ability. But at this stage the study and teaching of a subject as fundamental as quantum mechanics is greatly facilitated by the use of a textbook. This volume by Rojansky represents in the re-

viewer's opinion, the first suitable book of this sort. The few volumes designed for use as introductory text-books which have appeared in the past have been concerned almost exclusively with Schrödinger's differential equation. But very many, perhaps even a majority, of the applications employ matrices and operational methods. There are subjects such as theoretical spectroscopy in which the solution of Schrödinger's equation by the ordinary methods of the calculus of differential equations occupies only a small fraction of the papers and treatises. Hence it is undesirable to spend almost the whole of an introductory course on a detailed discussion of Schrödinger's equation, as such. This is especially true, since it seems to have the result that most students never grasp the general ideas of the quantum-mechanical method but cling to Schrödinger's differential equation as to a lone friend in a strange land. They try to write and employ horrible-looking differential equations where a few operational ideas would save many complicated pages. While this sort of thing has ample precedent in important early work of competent physicists, particularly in papers on spectroscopy, it should have been ended by the brilliant expositions of Dirac. But now for the first time do we have an introductory text-book which follows in Dirac's footsteps.

In examining this book one is appalled at the bulk, when presented in a truly introductory fashion, of the material which the student has to learn, has to have at his fingertips, before he is prepared to follow easily the literature employing quantum mechanics. The mathematical methods employed will seem to the student strange, but not more difficult than the courses in pure mathematics he is prepared to study. This is especially true since in an introduction to quantum mechanics, just as in an introduction to classical theoretical physics, neither too rigorous a mathematical treatment nor too logical a development of the physical postulates is necessary. In this connection Rojansky's book "makes little pretense to rigor and often aims to make plausible rather than to prove."

But in spite of the fact that the book succeeds in presenting very well and in a fashion as elementary as possible the tremendous machinery necessary to the understanding of the applications of quantum mechanics, it is not quite the ideal elementary text-book which one would advise a beginner to study by himself without benefit of lectures. For one is shocked at the idea of studying through the whole book and finding as little concrete physics as is there contained. As the book stands now it is a course in which one is taught to make many different mathematical manipulations on commands couched in physical terms, but has little idea as to why he is learning to make them. This is partly unavoidable, but can often be remedied by informal classroom discussion concerning the fields in which the various ideas are of particular use. Since this text makes no claim to logic or rigor, more of this informal discussion might well have been introduced to keep alive the student's interest. To give a few examples: the application to the nuclear vibration of molecules of the energy levels and transition probabilities found for a harmonic oscillator might have been discussed; the importance of the potential well for the study of metals and of gases might have been explained; cold emission could have been used as a second example (in addition to radioactivity) of the tunnel effect; and the diffraction of an electron beam passing through an idealized metal surface would have furnished an excellent application of de Broglie waves.

As we have noted, the book has practically nothing in the way of applications of the theory. It does get to the point of treating the hydrogen atom, including spin-orbit interaction and nuclear motion. But in general, as is proper, its function is to carry the student exactly to the point where specialized treatments of the applications of quantum mechanics are likely to begin. It discusses one-particle problems only, has no mention of the exclusion principle and practically nothing on radiation theory.

The commendable introductory chapter on classical mechanics is designed not so much for review as to introduce terms and notions fundamental in quantum mechanics but not usually employed in elementary classical mechanics. Thus the student, while still in familiar surroundings, encounters potential wells, distribution functions, expectation or average values, the uncertainty of the result of a measurement, the state of a system, probability packets.

This chapter is followed by an excellent formulation and discussion of the fundamental assumptions of quantum mechanics directly from an operational point of view; then a detailed treatment of the Schrödinger method in one dimension. One might refer to the particularly clear treatment of composite states, the brief but convincing exposition of the Heisenberg uncertainty principle, and the first treatment in an elementary book of the one-dimensional potential lattice.

Then follows an excellent treatment of operational and matrix methods. The student is gently introduced to the two sorts of matrices of particular interest—those representing Hermitian operators and unitary transformations—by a geometrical discussion of "mappings" and "frame changes."

At the end are chapters which treat the elements of motion in three dimensions, Pauli's theory of spin and Dirac's theory of the electron.

The book contains literally hundreds of carefully chosen problems which should be of great value in familiarizing the student with the employment of the quantum-mechanical methods.

The presentation of the subject is in general ex-

tremely clear and gives the impression of having been very carefully prepared. In this regard, the reviewer would have only one suggestion—that greater use might be made of graphical illustrations of the type so convincingly employed in Gurney's book. For example, for the case of hydrogen, a plot of $-1/r + l\,(l+1)/2r^2$ for various values of l, with the radial eigenfunctions superposed on the respective energy levels, renders very plausible the coincidences of these levels in this case and the lack of coincidences if the central field departs in the least from the Coulomb value.

Finally one might remark that the typography of the book is very pleasing and should serve as a model for other American texts. It approaches the English and German books for beauty of format, avoiding the ugly fat radicals, the huge thick integral signs and the black summation signs which so clutter up the pages of most American physics books; and goes far toward making the cuts and equations fit into and become an attractive part of the page instead of standing out like trees in the middle of South Dakota. One even finds (p. 515) an equation pleasantly protruding into the margins, a thing unheard of in American typography. One still finds, however, too much blank space around short equations (*e.g.*, p. 355).

GEORGE H. SHORTLEY

THE OHIO STATE UNIVERSITY

USES OF CHEMICALS

Uses and Applications of Chemicals and Related Materials. By THOMAS C. GREGORY. vi + 665 pp. New York: Reinhold Publishing Corporation, 1939. $10.00.

TWENTY-FIVE years ago, when we entered the World War, it became necessary for the Secretary of War to commandeer all supplies of various essential chemicals and allocate them according to our war needs. This allocation was made with the assistance and upon the advice of the Chemicals and Raw Materials Division of the War Industries Board. Even in a group of experts of this kind, it was not always possible to find men who were familiar with all the varied uses of a well-known chemical or the proportionate amounts required by various industries. For example, those no specialists had no idea of the quantity of arsenious acid required by the glass manufacturers or of saccharin by the tobacco industry.

Such a book as the one under review would have been very helpful, and it seems to the writer, therefore, that its appearance is opportune, now that we may be facing problems similar to those of 1917–18.

The volume describes, in alphabetical order, the current industrial uses, potential applications and sales possibilities of 5,167 chemicals and related products. It is based upon surveys made over a period of 15 years and published in the *Oil, Paint and Drug Reporter,* under the titles *"Where You Can Sell"* (up to and including the issue of September 9, 1935) and "Industrial Uses of Chemicals and Related Materials" (from the issue of September 16, 1935, onwards). The uses are classified under appropriate sub-headings; synonyms and foreign names are given, and patent references are frequent. At the close of the volume is an extensive "Synonyms and Cross References" index. The book is an encyclopedia of useful information.

MARSTON TAYLOR BOGERT

COLUMBIA UNIVERSITY

SPECIAL ARTICLES

THE SEMIQUINONE RADICALS OF METHYLENE BLUE AND RELATED DYESTUFFS

THE occurrence of free radicals, designated as semiquinones, as intermediate reduction products of reversibly reducible dyestuffs, was considered as an exceptional case when it was first discovered for pyocyanine and some related phenazin derivatives. Meanwhile, these radicals have been shown to exist for all the more familiar classes of reversible dyestuffs, except for the thiazines and oxazines. Since methylene blue, a thiazine, is the most frequently used dyestuff in biochemical research, the failure of any report about the existence of its semiquinone was somewhat puzzling. This problem is especially important with regard to the hypothesis of compulsory univalent reduction[1] which claims that no oxidation or reduction can proceed with

[1] L. Michaelis and C. V. Smythe, *Ann. Review Biochemistry,* 1938.

any appreciable speed otherwise than in univalent steps. The faculty of acting as a catalyst for oxidation, especially respiration, should accordingly also be correlated with the faculty of the catalyst to be either a univalent oxidation-reduction system, such as the iron porphyrin compounds; or if it be a bivalent system, to be reducible in two successive, although more or less overlapping steps.

This note is to give a preliminary report on the discovery of the hitherto unknown semiquinones of these dyestuffs.
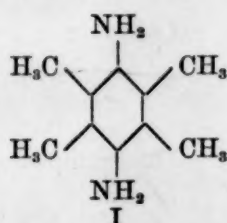
According to the theory on stability of free radicals, based on the theory of reasonance, the authors came to the conclusion that the radicals of thiazines should be most stable in a very strongly acid solution. This expectation has been verified by experiment. It is easiest to demonstrate the radical of thionin (Lauth's

let). When a solution of the dye in 20 NH_2SO_4 reduced, say by $TiCl_3$, the free radical appears as termediate step of reduction. It is yellow and exhibits a series of distinct absorption bands in the blue t of the spectrum, recalling the bands of the triphenylmethyl radical. Analyses of the potentiometric ration curves, obtained by especially adapting the technique to the unusually high acidity of the solutions, owed that this yellow compound is a free radical, t a polymerized compound. The separation of the o steps rapidly diminishes with decreasing acidity t never vanishes entirely. Even in neutral solution analysis of the potentiometric titration curves reals that the dye solution in its half-reduced state contains the semiquinone to an extent that may be estimated as between 5 per cent. and 10 per cent. of the al dye. In such solutions the radical can no longer detected, optically, for two reasons. Firstly, a few cent. of a light yellow compound escapes optical ection when mixed with the large excess of the ply colored blue dyestuff itself; secondly, it can be amed from theoretical arguments that the radical is a different state of ionization in extremely acid, than less acid or neutral solution, and that the form existing in neutral solution should exhibit an extremely ght absorption, if any at all, in the visible range of ave-lengths.

The only difference between thionin and methylene e is that the latter requires still a somewhat higher idity than thionin in order to obtain the same degree separation of the two steps of oxidation. The absorption spectrum of the methylene blue radical is ite similar to that of thionin.

Then, these dyestuffs, after all, fit very well into the ory of compulsory univalent oxidation. Any bivalent oxidation reduction system must be capable of rming a semiquinone radical to a measurable extent order to behave as a reversible system; and any ganic dyestuff can act as a catalyst for sluggish idations only by intermediation of the radical.

Another experiment should be mentioned with regard to the assertion that the catalytic action of a dye pends on its faculty to form a semiquinone radical. has been shown recently,[2] that the first oxidation oduct of diamino durene (I) is a free radical, analous to those designated as Wurster's dyes. It has en shown furthermore that any methylation at the

I

L. Michaelis, M. P. Schubert and S. Granick, *Jour. Chem. Soc.*, 61: 1981, 1939.

amino groups destroys the faculty of forming this radical. In the latter case, the benzene ring, the two N atoms and all the atoms attached to the two N atoms are prevented from lying in one plane due to steric hindrance of the voluminous side chains. The steric possibility of such a coplanar arrangement is requisite for establishment of resonance. For this reason the methylated compounds can not form a radical. Now, the unmethylated compound increases respiration of erythrocytes to approximately the same extent as does methylene blue, but the methylated compound has no catalytic effect at all.

S. GRANICK
L. MICHAELIS
M. P. SCHUBERT

THE ROCKEFELLER INSTITUTE FOR
MEDICAL RESEARCH, NEW YORK

THE METABOLISM OF GLUTATHIONE[1]

INVESTIGATIONS concerned with the fate of glutathione in the living organism have dealt almost exclusively with the behavior of the tripeptide as an SH-carrier. The methods used have been based on determination of the SH-group.

Little attention has been paid to the possibility that the combination of the three amino acids, glycine, cystine and glutamic acid in this peptide, GSH, has some special significance aside from its function as an SH-carrier. It is striking that these three amino acids are the ones which are found combined with compounds other than amino acids in the mammalian body, *e.g.*, bile acids and the products of detoxication. One of us has previously suggested that GSH may act as an amino acid donor in the formation of those compounds.[2] In support of this conception a decrease in the substances titratable with iodine in human blood was found after intake of phenyl acetic acid which is excreted as phenyl acetyl glutamine.[3]

It is now possible by the use of the isotope technique to follow directly the fate of the amino acids of GSH and to estimate its rate of turnover. Glycine containing 1.18 atom per cent. N^{15} excess was administered to rats. After two hours the concentration of N^{15} in the GSH of the liver and intestine, together with the N^{15} content of the protein glycine and NPN of these organs, was determined. The GSH was isolated as follows: The frozen and ground livers were extracted with metaphosphoric acid. The GSH was precipitated as the cuprous compound and purified by reprecipitation. The method of isolation yields about 16 mg of copper glutathione per rat liver, correspond-

[2] H. Waelsch, *Arch. exper. Path. u. Pharm.*, 156: 356, 1930.
[3] H. Waelsch and E. Weinberger, *ibid.*, 156: 370, 1930.

ing to 30 to 40 per cent. of the values given by titration procedures.

The results (Table I) show that within 2 hours an

TABLE I

RATS GIVEN 75 MG. GLYCINE (1.18 ATOM PER CENT. N[15] EXCESS)

Liver	N[15] excess atom per cent.	Dilution factor of labeled N	Dilution factor of labeled glycine
Cu glutathione	0.09	1 : 13	1 : 4.3
NPN	0.04	1 : 29	
Glycine (protein)	0.019	1 : 62	1 : 62
Intestine :			
Cu glutathione	0.038	1 : 31	1 : 10.3
NPN	0.014	1 : 84	
Glycine (protein)	0.017	1 : 70	1 : 70

appreciable part (7.6 per cent.) of the nitrogen of the liver GSH was derived from the administered glycine. By contrast the nitrogen of the protein glycine and of the NPN of the liver represented only 1.6 and 3.4 per cent. respectively. A similar relationship was found in the intestine. In view of the short period of the experiment and of the finding by Braunstein and Kritzmann,[4] Bach[5] and others that the speed of deamination of glycine is slow it is probable that all the labeled N is in the glycine portion of the GSH. If this assumption is correct the concentration of N[15] in the glycine of the liver GSH would be 3×0.09 atom per cent. and the minimum rate of turnover of GSH would be 22.3 per cent. (intestine 9.6 per cent.) in two hours (Table I, column 4). By contrast in the same period only 1.6 per cent. (intestine 1.5 per cent.) of the protein-glycine of the liver was exchanged. This experiment establishes the fact that GSH is a very unstable and reactive compound in the living organism.

Rittenberg and Schoenheimer[6] administered benzoic acid and glycine labeled with N[15] to rats. One third of the glycine excreted as hippuric acid during the following 24 hours came from the glycine administered. To obtain further information concerning the synthesis of hippuric acid in relation to the turnover of GSH, benzoic acid and glycine containing 1.98 per cent. of N[15] excess were injected subcutaneously into rats. After five hours GSH was isolated from the liver. The GSH contained 0.151 atom per cent. N[15] excess. Assuming again that it represents an uptake of labeled glycine by the GSH the minimum rate of turnover of the GSH from the liver would be 23 per cent.

Hippuric acid isolated from the urine collected during the five-hour period contained 1.08 per cent. N[15] excess, indicating that 55 per cent. of the glycine of the hippuric acid was derived from administered

glycine. Since the liver GSH glycine contained less N[15] (0.453 atom per cent. excess) at the time it was measured than did the excreted hippuric acid (1.08 atom per cent. excess) the experiment offers no support for the hypothesis that GSH furnishes glycine for hippuric acid formation.

Further work is in progress to determine whether the rapid turnover of GSH is indicative of its role as an intermediary in the metabolism of proteins.

H. WAELSCH

DEPARTMENT OF BIOCHEMISTRY,
NEW YORK STATE PSYCHIATRIC INSTITUTE
AND HOSPITAL, NEW YORK, AND
DEPARTMENT OF NEUROLOGY,
COLUMBIA UNIVERSITY

D. RITTENBERG

DEPARTMENT OF BIOCHEMISTRY,
COLUMBIA UNIVERSITY

SYNTHETIC ALPHA–TOCOPHEROL AND NUTRITIONAL MUSCULAR DYSTROPHY[1]

RECENTLY Goettsch and Ritzman[2] found that alpha-tocopherol prevented the development of muscular dystrophy in young rats when alpha-tocopherol was fed from the tenth to the twenty-fifth day after birth. Control rats under similar conditions but without the supplement of alpha-tocopherol showed symptoms of muscular dystrophy at the end of the above test period. Their own criticism of the results was that it was conceivable that the alpha-tocopherol employed might have contained impurities that were active in preventing the muscular disease. The alpha-tocopherol was a natural product isolated according to the method of Evans, Emerson and Emerson.[3]

Mackenzie and McCollum[4] later showed that the natural alpha-tocopherol was effective in curing muscular dystrophy of rabbits on the Goettsch and Pappenheimer diet no. 13 plus 10 per cent. of ether extracted wheat germ.

In the present work with muscular dystrophy of rabbits, the writer has used a diet consisting of ground U. S. No. 3 grade alfalfa hay ad libitum, and 20 grams of a grain mixture daily per rabbit. The grain mixture is made up of 40 parts of whole yellow corn meal, 30 parts of wheat bran, 20 parts of soybean meal and 10 parts of linseed meal. One part of sodium chloride is added to the mixture. Each animal received daily 1 cc of a good grade cod liver oil, either placed upon

[1] This research was supported by an appropriation from Bankhead-Jones funds (the Bankhead-Jones Act of June 29, 1935).

[2] M. Goettsch and J. Ritzman, *Jour. of Nutrition,* 17: 371, 1939.

[3] H. M. Evans, O. H. Emerson and G. A. Emerson, *Jour. of Biol. Chem.,* 113: 319, 1936.

[4] C. G. Mackenzie and E. V. McCollum, SCIENCE, 2312, 370, 1939.

[4] D. F. Braunstein and M. G. Kritzmann, *Biokhimiya,* 3 : 590, 1938, C.A. 33, 2916, 1939.

[5] S. J. Bach, *Biochem. Jour.,* 33: 90, 1939.

[6] D. Rittenberg and R. Schoenheimer, *Jour. Biol. Chem.,* 127: 329, 1939.

the grain or by mouth. Muscular dystrophy can be produced equally well when petroleum ether extracted No. 1 alfalfa hay replaces the No. 3 alfalfa hay.

The muscular dystrophy producing property of this diet is dependent upon the cod liver oil. This is in agreement with the report of Madsen, McCay and Maynard[5] that cod liver oil added to a synthetic diet increased the rate of development and early severity of the muscular dystrophy. The water-soluble factor associated with nutritional muscular dystrophy as indicated by Morgulis, Wilder and Eppstein[6] is not lacking in this diet.

In this laboratory feeding of alpha-tocopherol,[3] prepared from wheat germ oil[7] has cured muscular dystrophy of rabbits, confirming the findings of Mackenzie and McCollum. Recently 300 milligrams of synthetic alpha-tocopherol[8] were obtained. Six rabbits suffering from muscular dystrophy but still able to walk with difficulty were given doses of this synthetic material. Experience would indicate that each of these rabbits, if left untreated, would within 24 hours have been unable to stand or consume food.

The individual doses of the synthetic alpha-tocopherol in milligrams were as follows: 17, 18, 20, 26, 51 and 65. All animals were cured except the one receiving the 17 milligram dose. A seventh animal which received 30 milligrams also died, but it was in a much more advanced stage of collapse at the time of treatment.

It is apparent that 20 milligrams is near the lower limit as a single curative dose. An animal is considered as cured when it loses its stiffness and begins to gain in weight within 48 hours and continues to gain for 10 days or more. Although no attempt is made to establish the minimum curative dose with such limited amounts of material, it is definitely shown that synthetic alpha-tocopherol will cure muscular dystrophy in rabbits as produced experimentally under the conditions stated. The 5 cures become more significant when one considers that from several hundred dystrophic animals we have never observed spontaneous cure of an untreated animal.

STEWARD G. MORRIS

U. S. DEPARTMENT OF AGRICULTURE

SCIENTIFIC APPARATUS AND LABORATORY METHODS

STUDENT APPARATUS FOR ANALYSIS OF RESPIRATORY GASES

THE gas burette to be described was devised especially for medical students for whose instruction analyses of expired air are required of just sufficient accuracy to illustrate the general principles of respiratory exchange and metabolism. The usual complicated apparatus (*e.g.*, the Haldane-Henderson) is, we believe, poorly adapted to this type of instruction, for several reasons: (1) too much time is required to acquire proficiency with the method; (2) due to the excessive cost per unit insufficient apparatus is available; (3) the size of the equipment makes storage a problem; and (4) the difficulty of cleaning the apparatus when it becomes fouled, as so frequently happens, imposes a severe strain on the time and patience of the instructor.

By the simple method, here reported, an inexperienced operator may determine the CO_2 and O_2 of expired air with an error not often exceeding 0.1 volume per cent., corresponding to an error of about 5 per cent. in the calculated value of the metabolic rate. The time required for an analysis (30 to 60

minutes) may seem excessive, but students can actually make more determinations, during the limited period available for the work in respiration, than they can with the ordinary methods. It is suggested, in view of the low cost of the equipment, that each unit consist of two burettes, mounted together for simultaneous determinations. In this way the average time of an analysis will compare favorably with that required by the Haldane-Henderson method.

APPARATUS

The burette[1] is of Pyrex glass, with replaceable stopcock of the type which requires little or no lubricant. The graduations, which extend from the cock to 10 cc by 0.05 cc intervals, should be calibrated to within 0.005 cc for total and partial volumes. The burette should be carefully cleaned to allow complete drainage of the reagents. The leveling bulb should contain approximately 35 cc, and it may be conveniently suspended by a cord wrapped once over a horizontal rod, and a large rubber stopper may be used as counterweight. A thermometer reading to 0.2° C. should be available to each group of students.

REAGENTS

(1) Solution of NaCl (U.S.P.) 23.5 per cent. by weight, having a specific gravity of 1.18, to which is

[5] L. L. Madsen, C. M. McCay and L. A. Maynard, *Proc. Soc. Exp. Biol. and Med.*, 30: 1434, 1933.

[6] S. Morgulis, V. M. Wilder and S. H. Eppstein, *Jour. of Nutrition*, 16: 219, 1938.

[7] The wheat germ oil from which the tocopherol was prepared was kindly supplied by the Archer-Daniel-Midland Company, Minneapolis, Minn.

[8] The synthetic alpha-tocopherol was furnished by Merck and Company through the courtesy of Dr. J. M. Carlisle.

[1] A suitable burette may be obtained from the Scientific Apparatus Company, Bloomfield, N. J., or from the Fisher Scientific Company, Pittsburgh, Pa.

added 5 cc of 85 per cent. lactic acid per 1,000 grams of salt solution. Phenol red or other indicator may be added if desired. Approximately 150 cc of the acid-saline is required for each analysis. The solution may be dispensed from stock in 500 cc cylinders, for convenient filling of the apparatus.

(2) Solution of NaOH, 16.0 per cent. by weight, having a specific gravity and vapor pressure approximately the same as the salt solution, for absorption
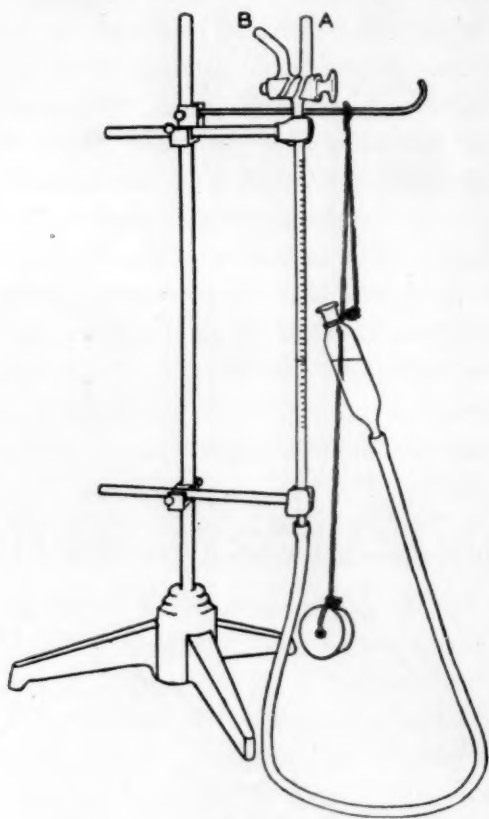

FIG. 1

of CO_2 and rinsing down of oxygen absorber. A single separatory funnel, with pipette-like tip, will allow the reagent to be conveniently accessible to the operators of 3 or 4 sets of apparatus.

(3) Oxygen absorber, consisting of 10 grams sodium hydrosulfite (Baker) and 1 gram sodium anthraquinone β sulfonate (Eastman) dissolved rapidly in 50 cc of 3N KOH, filtered through cotton and stored in a separatory funnel under paraffin oil. A single container should supply 6 to 10 students.

PROCEDURES

Levelling bulb, tubing and burette are filled with salt solution and about 1 cc is run into the reagent cup "A," a gas sample is then introduced through the tube "B" to approximately the 10 cc mark. Most of the saline is run in from the cup, the cock is closed, and the burette tapped to dislodge traces of solution from the upper end. Levels are adjusted and readings recorded at intervals until drainage is complete, which may require 5 to 15 minutes. The room temperature should be noted to the nearest 0.2° C. in vicinity of the burette. It is essential that the gas sample should be protected from sunlight or other causes of sudden variation of temperature. To this end the operator should remain at least 3 feet distant from the burette except during necessary manipulations, for heat radiated by the body may elevate the temperature of the gas without affecting the thermometer. A water jacket will not assist in maintaining constancy of temperature, for the heat of neutralization and of dilution which is liberated during the analysis must be completely dissipated, a process which occurs most quickly by air conduction.

CO_2 is now absorbed by running in 2 cc of the alkali, during about a minute. Time for complete drainage of the alkali rarely exceeds 8 minutes. Levels should be adjusted for the new reading and the temperature should be recorded. The volume of the gas should be corrected in each instance for temperature changes greater than 0.5° C.

O_2 is absorbed by running in 3 to 4 cc of the hydrosulfite reagent during approximately 2 minutes. To facilitate complete drainage and to avoid errors due to vapor pressure differences, the hydrosulfite should be washed down with 4 to 5 cc of the NaOH solution. Complete drainage may require from 10 to 15 minutes. The temperature, corresponding to the final volume, should be recorded.

After each analysis the fluid is run out by lowering the leveling bulb to a container placed on the floor. The burette is then washed through the reagent cup with 5 to 10 cc of NaOH, followed by water, followed by saline. The leveling bulb is then raised and refilled with saline. If sulfur scum appears in the burette it may be necessary to discard the first filling.

Since incomplete drainage is the chief source of error of the method, scrupulous attention should be paid to this factor.

During changeable weather it is advisable to record the barometric pressure and to make appropriate corrections of the gas volume.

J. MAX LITTLE
HERBERT S. WELLS

PHYSIOLOGY DEPARTMENT,
VANDERBILT UNIVERSITY SCHOOL
OF MEDICINE

BOOKS RECEIVED

ANDERSON, J. RINGLAND. *Hydrophthalmia of Congenital Glaucoma; Its Causes, Treatment and Cure.* Pp. xv + 377. Cambridge University Press, Macmillan. $7.00.

DICKSON, LEONARD E. *Modern Elementary Theory of Numbers.* Pp. vii + 309. University of Chicago Press. $3.00.

MORGAN, ALFRED P. *The Pageant of Electricity.* Pp. xxvi + 363. Illustrated. Appleton-Century. $3.50.

National Resources Committee. *The Structure of the American Economy; Part I, Basic Characteristics.* Pp. vii + 396. Illustrated. Superintendent of Documents, Washington, D. C. $1.00.